SCIENTIFIC AMERICAN

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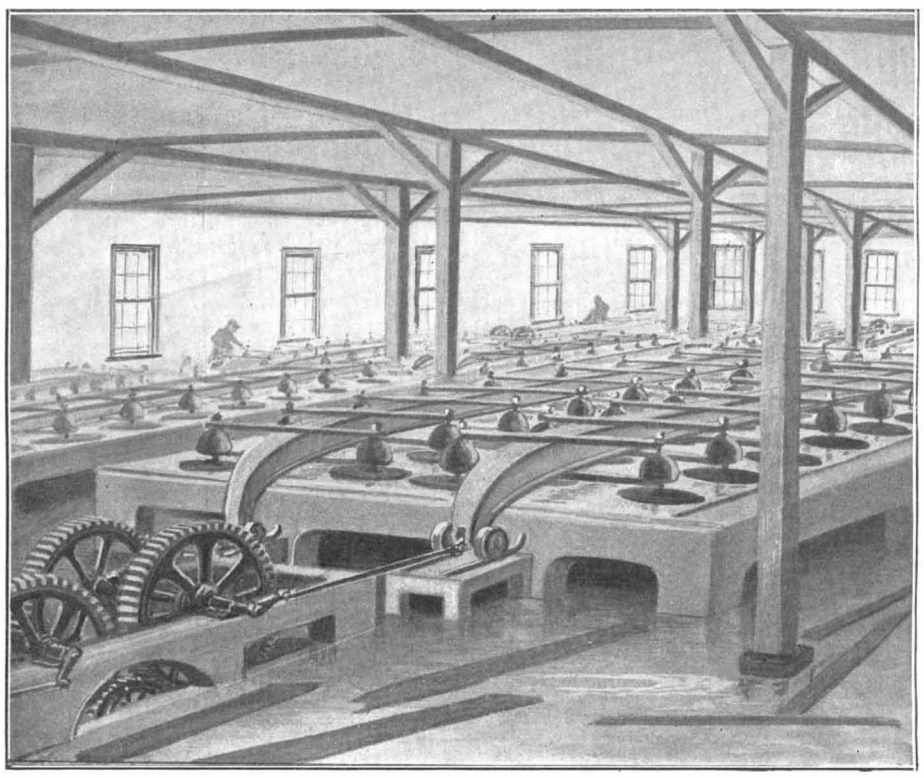

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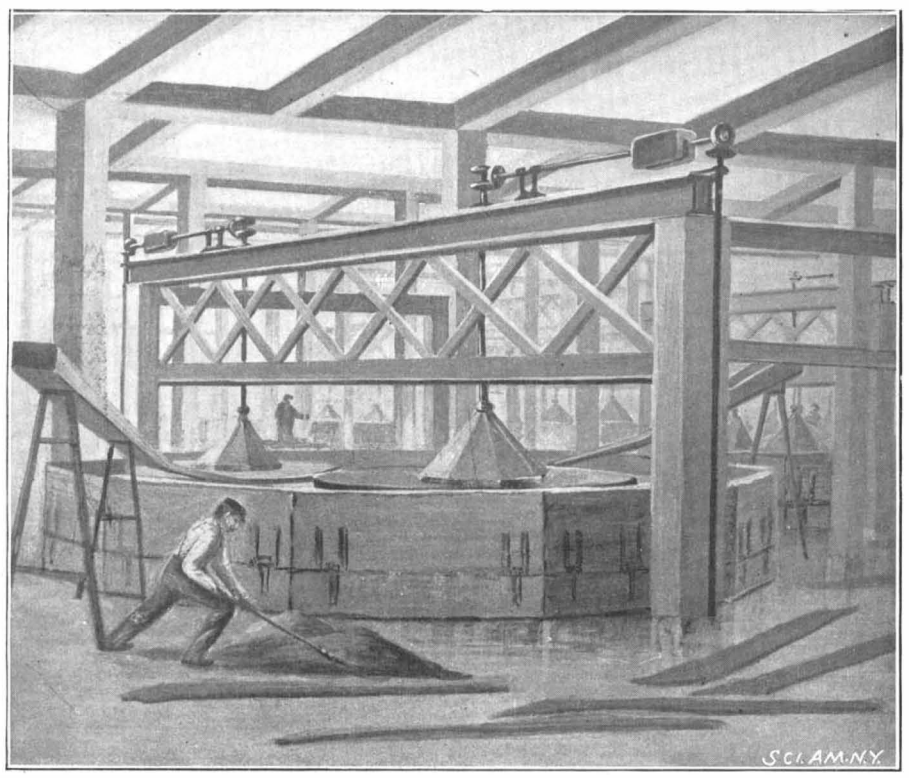
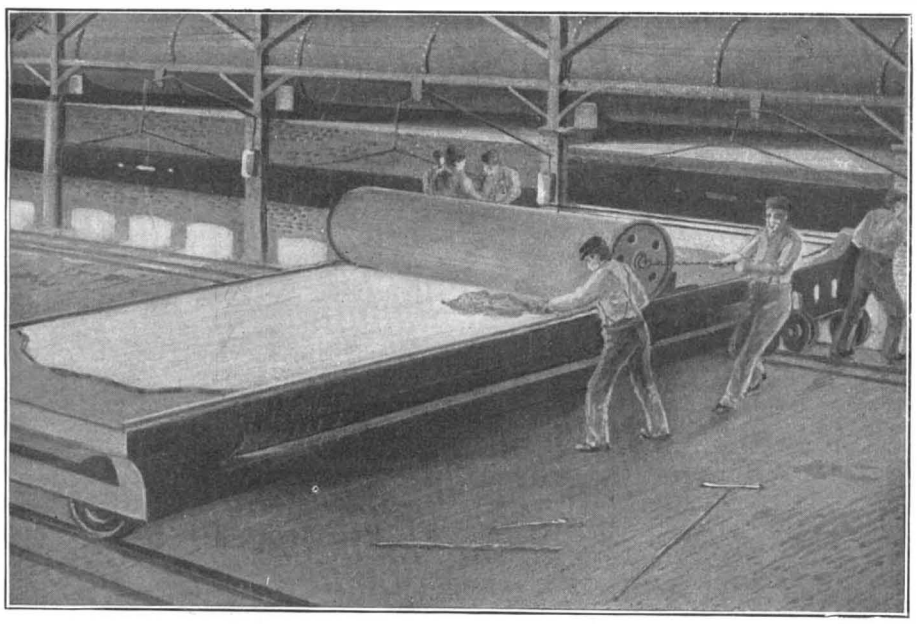
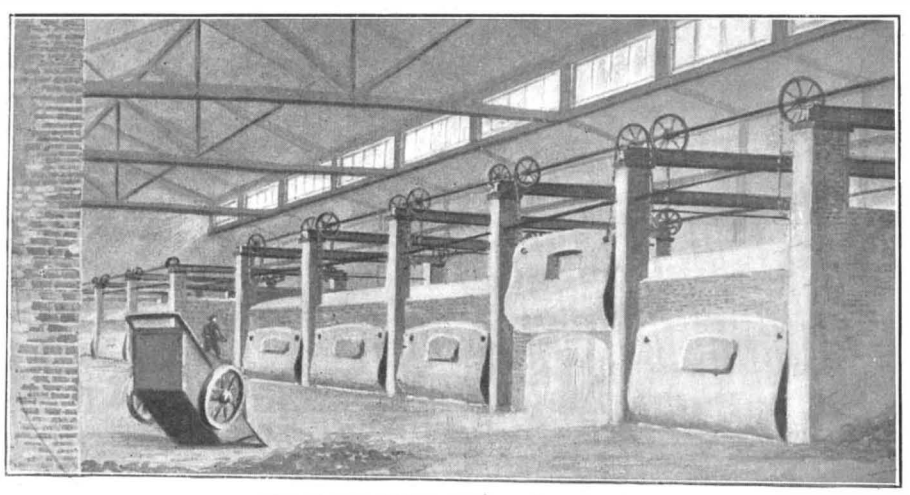


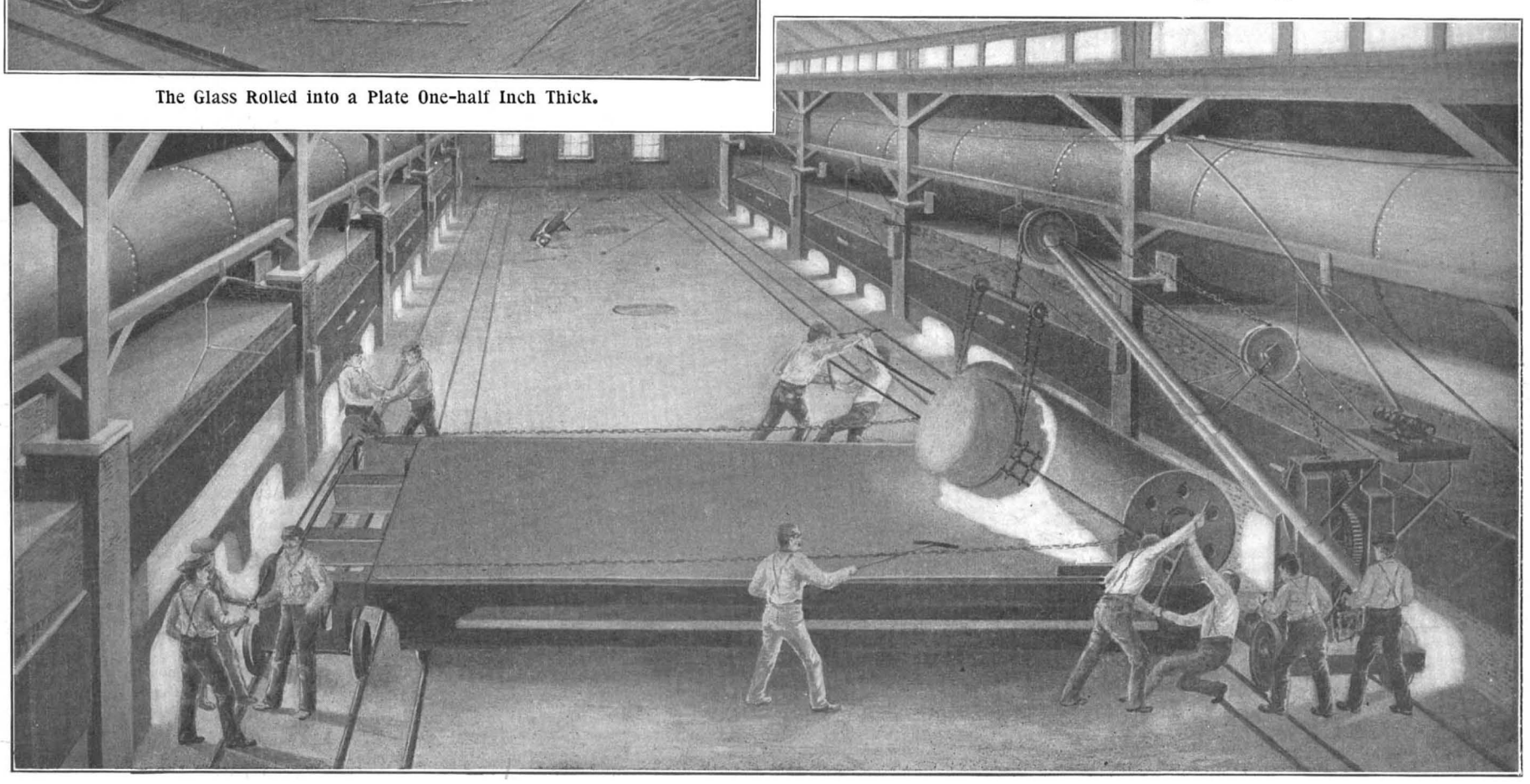
Rough Grinding.



The Glass Rolled into a Plate One-half Inch Thick.



The Front of the Melting Furnaces.



Pouring the Molten Glass on to the Casting Table.

MANUFACTURE OF PLATE GLASS.—[See page 311.]

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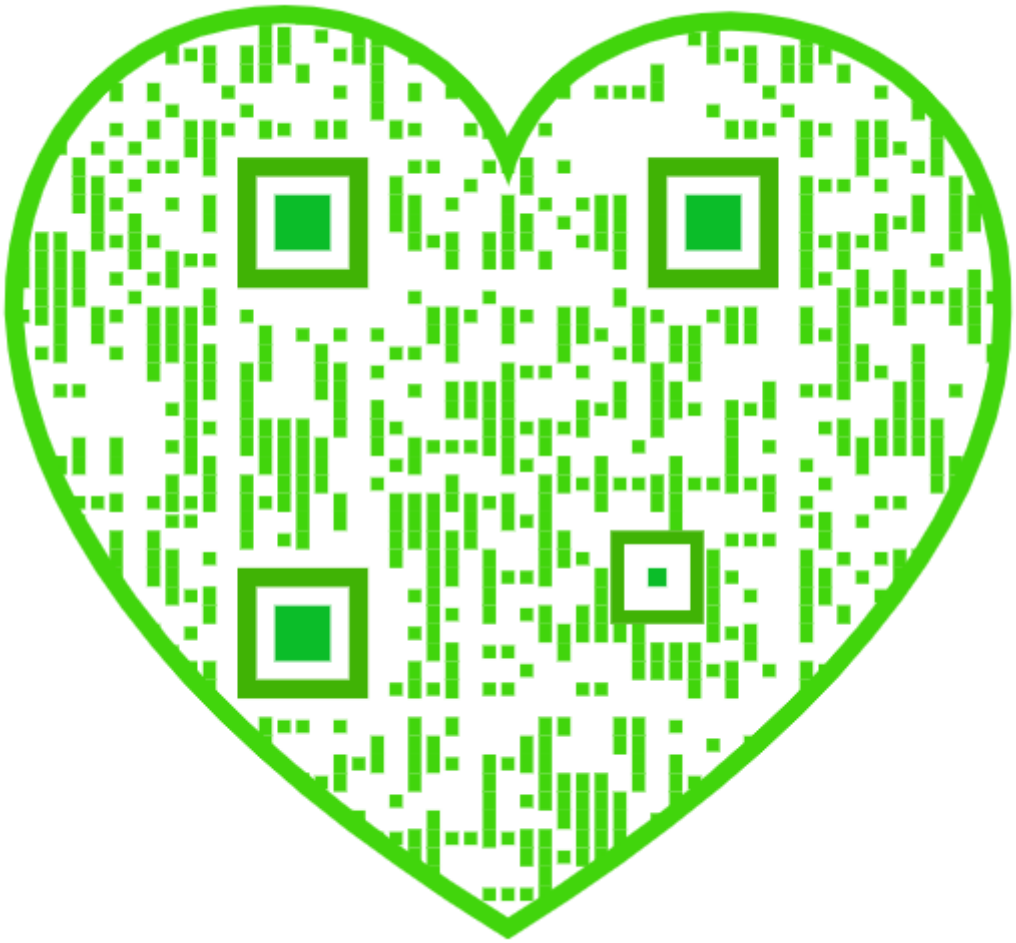

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NEW YORK, SATURDAY, MAY 18, 1901.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE EXISTENCE OF BODIES SMALLER THAN ATOMS—THE CORPUSCULAR HYPOTHESIS.

If Prof. J. J. Thomson's corpuscular hypothesis be absolutely demonstrated, our ideas in regard to chemistry will be revolutionized. In a recent lecture before the Royal Institution he selected as his subject "The Existence of Bodies Smaller than Atoms." He briefly referred to work which had been done by others in theory and practice, in order to determine the size of an atom. One method of doing this was by ascertaining the charge of electricity which an atom carried during the process of electrolysis, and from the charge to calculate the mass. The experiments of the lecturer were made with the view of ascertaining the mass of small particles which carry an electric discharge through attenuated gases. The next experiment was made with the object of ascertaining the mass of all the particles used to carry the charge and also their number. For this purpose some of the experiments of Mr. Wilson on the sudden expansion of a gas saturated with moisture were used. He found that a cloud was not produced by the sudden expansion if the air was quite free from dust. It was also found that if either the dust or the charged particles of gas were present a cloud was formed. The total quantity of moisture in the cloud can be calculated from the expansion. Some experiments of Prof. George Stokes were then employed to ascertain the volume of each particle. These experiments had for their end the careful determination of the rate at which particles of water would fall, the speed being dependent upon the dimensions. From the formula which Prof. Thomson obtained, he was able to ascertain the size of the particles by observing the time it took for the cloud formed in the tube by a sudden expansion to fall. Once he knew the size of one particle and the total mass, it was not difficult to make calculations. He concluded that the small particles carrying the charges of electricity were only one-thousandth of the size of an atom. These experiments were all made with discharges of negative electricity. It was also found that these small particles negatively charged were given off from incandescent matter and from radium.

Prof. Thomson expressed mathematically the laws of Becquerel and cathode rays and then showed from his equations that the rays possessed momentum and, therefore, must have mass. When he first enumerated his theory to the scientific world three or four years ago, it was received with considerable incredulity, but has now been adopted by many scientists. He regards the chemical atom as made up of a large number of similar bodies which he calls "corpuscles." A normal atom forms a system which is electrically neutral. The electrification of a gas consists in the breaking off from the atoms of a few corpuscles. The remainder of the atom is positively electrified, and the more corpuscles that are broken off the stronger is the attraction that binds the remainder to the atom.

Prof. Thomson has calculated from the results of his experiments on very different substances that the mass of a negative corpuscle is about the five-hundredth part of the hydrogen atom. The subject is treated at considerable length in the current issue of our SUPPLEMENT.

PROPOSED ABOLITION OF THE ARMY TRANSPORT SERVICE ON THE ATLANTIC.

We greatly regret to learn that the United States Army Quartermaster in this city has received notice from the War Department to close contracts with the steamship companies running between New York and the West Indies, for the transfer of men and material between the United States and Cuba and Porto Rico. The reason given for this radical change of policy is, that the steamship companies concerned are said to have offered rates to and from the West Indian military depots, which are lower than the actual cost for similar service as carried on by the regular army transports. This statement, however, is not authenticated, and we seriously doubt its truth.

If our readers turn to the articles published in the SCIENTIFIC AMERICAN for March 23 and April 27, 1901, giving an account of the army transport service on the Atlantic and Pacific, they will find some statement of the costs of operation as compared with the cost of similar service if carried on by the civil lines. A recent voyage of the "Crook" from New York to San Juan and return cost $9,761.39, whereas the cost estimated at the current rates of the civil lines of steamships at the time the voyage was made would have been $19,907.00, a clear saving of $10,145.61. Another voyage of the "Crook" between the same ports would have cost $26,419.28 if the men and supplies had been carried by the regular lines, whereas the actual cost by the army transport vessel was $14,062.93, a clear saving of $12,356.35. In the presence of such figures as these one is filled with very natural astonishment on learning that it is proposed to abolish a system which has proved itself so highly economical, and to transfer the whole of the service into the hands of civil corporations. The change may well prove to be highly profitable to the latter; but the profit will be at the expense of the government, and the whole proceeding will savor of that paternalism and pseudo-benevolence, the last vestige of which we had hoped was disappearing from our national affairs.

The question of the abolition of the transport service, however, is to be deprecated on higher grounds than that of mere finance. One of the great lessons which we have learned, or rather which we ought to have learned, during our war with Spain, a lesson, by the way, which has received strong indorsement in the naval transport operations of the South African war, is that army transport service on the sea is second only in importance to army transport service on land, and that it is just as essential that the army should have a fleet of its own furnished with accommodations suited to its particular needs, as it is that it should have its own special wagons and packing outfit for transportation on land. If we are to abolish army ships and put up with the haphazard accommodation of private steamships, let us be consistent and abolish army wagons, cars and what-nots and benevolently call in the farmer and huckster to help us out with whatever vehicles may be on the farm or in the stable, much after the fashion of poor old Braddock when he went to his defeat in colonial days. As a matter of fact, the needs of the army transport service are so special that it is impossible for any private steamship to meet them. Proof of this is shown in the fact that when such steamships have been purchased for the transport service, it has been necessary to spend about $400,000 in the mere work of refitting them with the necessary bunks, lavatories, hospitals and accommodations for provisions and freight.

Nor must we forget the most powerful argument of all in favor of a separate service, namely, that since wars come swiftly and with but little warning, a fleet of troopships specially fitted for the conveyance of an army and its supplies, and available for duty at any time that it may be called upon, is an imperative necessity. For proof of this statement, it is enough to refer back to the precipitate scramble which occurred in scraping together enough ships to carry our army to Cuba, and to the pitiable sufferings to which the invalided troops were subjected on account of the insufficiency and unfitness of the extemporized troopships which brought home the sick and wounded soldiers.

Looked at from any and all points of view, there are very positive advantages in the possession by the navy of a large fleet of thoroughly equipped transports, with as many of them on the active list as will meet the needs of the army when it is on a peace footing, and the rest in reserve in such a state of readiness that they can be rushed into service at a few days' notice. Indeed, so firmly are we convinced of the wisdom of this policy that we think the construction of ships designed and equipped specially for this service is as necessary to efficiency as the construction of ships of war for line of battle and for scouting on the high seas.

A NEW TYPE OF COAST DEFENSE GUN.

The Gathmann gun, a detailed description of which will be found on another page, was built in consequence of an appropriation made by Congress in March, 1899, and was proved at the Bethlehem Steel Company's proving grounds in the summer of 1900. The Bethlehem Steel Company undertook to design and build the gun complete—the problem set being to produce a gun weighing about 59 tons which would fire a projectile weighing 2,000 pounds with 1,800 feet velocity, and would safely withstand a chamber pressure of 18,000 pounds per square inch.

In a recent communication to this journal Lieut. Meigs, Ordnance Engineer of the Bethlehem Steel Company, informs us that the ratio of the muzzle energy of this gun at 2,200 feet velocity, which the gun can safely reach, to its weight is to that of the ordinary type of gun usual in this country and abroad as 125 is to 100. That is to say, for a fixed weight of gun this one is about 25 per cent more economical in its performance, that is, in its rendering of muzzle energy, which constitutes the destructive power in projectiles. To look at it in another way, this gun will have great power upon armor or any other target in consequence of the weight of its projectile, which is very great as compared with the weight of the gun. Its *smashing* or *racking* effect, to use a term which was often met with in artillery matters at the time our monitors were built in the civil war, is very great.

The gun is now at Sandy Hook, and at its last session Congress made an additional appropriation which will enable the inventors to purchase a number of projectiles for the further proof of the gun. For while the gun is interesting as above indicated, owing to its large bore for its weight, the primary intention of its inventors is to use it as a torpedo gun. The projectile will carry 500 pounds of guncotton or other high explosive, and it is believed that, upon detonation of so large a mass of guncotton, even outside of a fort or ship, great destruction will ensue. It is now to be shown that a charge of this size can be safely landed on a structure which it is intended to destroy, and there completely detonated by the action of the fuse. Even, however, if the danger of firing so large a charge from a gun prohibit its use, or if so large a charge cannot be completely detonated in close contact with a target, which is necessary for the full effect of the explosive, it still remains that the Gathmann 18-inch gun is an extremely interesting one; for the reason that, for the weight of the gun, it strikes a more destructive blow, except possibly at very great ranges, than existing guns. If the greater blow it strikes includes practically all distances at which ordinary targets can be hit at all, which distance artillerists will place perhaps between 4,000 and 8,000 yards, then these large-bored guns have much to recommend them.

"SHAMROCK" AND "CONSTITUTION."

Limitations of space prevent our offering for comparison with the views of "Constitution" which will be found on another page, some photographs of "Shamrock," taken as she was starting from the Clyde. These views, which give an excellent idea of the lines of the challenger, will be found in the current issue of the SUPPLEMENT. If our readers compare the two boats, they will agree with us that the models of the yachts, as far as can be judged from their above-water lines, are radically different. The beam of "Shamrock," at least in the deck-plan, has been maintained to well abreast of the mast, while the boat begins to narrow in from slightly abaft the chain plates and is drawn out into a stern which certainly does not measure more than 6 feet across the taffrail. The photographs also show that her freeboard has been reduced to something less than four feet amidships, so that while Mr. Herreshoff has been increasing the height of his topsides, Mr. Watson has been going to the opposite extreme. What renders this more curious is the fact that, judging from her lines, the Watson boat will have less initial stability, and would, therefore, seem to require the deeper topsides to lie down upon. Another curious fact brought out by the photographs of the English cutter is that the sail-spread will evidently be much smaller than has been reported, and certainly smaller that that of the American boats. The value of the time-allowance thus gained will depend entirely upon the strength of the wind in which the races are sailed.

NEW ELECTRIC TRACTION SYSTEMS IN EUROPE.

Among the numerous systems of electric traction which are being installed in Europe may be mentioned the following: Bilbao, Spain, is to have a traction system, and the lines from that city to Durango and Arratia will be transferred to electric traction; the material has been ordered from the French Thomson-Houston Company. The energy for operating the lines will be supplied by two hydraulic plants which will furnish current at high tension, and this will be carried over a distance of 10 miles to the sub-stations, where it will be transformed to direct current at low potential by rotary converters. The total length of the tramway lines is to be 11 miles, most of which is double track. In Sicily a number of installations are in projection. Up to the present none of the cities of the island are provided with electric tramways. Palermo will be one of the first of these to have a lighting and traction plant; this is being installed by the Schuckert Company. The Allgemeine Company, another large German firm, is soon to undertake several important projects in Sicily. The Helios Company, of Cologne, has already installed a 2,000 horse power plant at Catania, on the

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east coast of the island, to operate a system of electric tramways. A French company has recently obtained the concession for an interurban line connecting Trapani, on the west coast, with Monte S. Giuliano and Paperella. Electric traction is to be substituted for steam at Messina; the existing system has a narrow gage road about 10 miles long. At Athens a system of lighting and traction is now being installed; the generating station will at first be equipped with two alternators of the triphase type, of 750 kilowatts capacity each, and the number of machines will afterward be increased to 6 or 7 according to the demands of the service. The alternating current will be sent to substations where it will be transformed to direct current; besides, the main station is to contain several direct current generators which will supply a part of the circuits.

VARIABILITY IN LIGHT OF EROS.

The discovery by Dr. Oppolzer that the light of Eros is variable suggests some photometric problems of great interest. If, as seems probable, we assume that the variation is due to the rotation of the planet, we can, from measures of its light, determine the time of rotation, and the direction in space of the axis of rotation. Owing to the varying position of the observer with regard to the planet, much information can be obtained which is impossible in the case of a variable star.

Assuming that the variation in light of Eros is due to its rotation, two explanations may be offered as in the case of variable stars of short period. First, that Eros is darker on one side than on the other, as is probably the case with Iapetus, the outer satellite of Saturn, and secondly, that it is elongated, or double, as has been assumed by M. André and others. In the first case, the successive maxima would always have the same intensity, and would succeed each other at equal intervals which would be equal to the period of revolution. The same would be true for the minima. In the second case, if the two bodies differed in diameter, the successive maxima and minima might have unequal intensities, and if the orbit were elliptical the intervals between them would be alternately long and short. This seems to be the case with Eros, and the first hypothesis seems therefore improbable.

On the other hand, if the variation in light is caused by two similar bodies alternately eclipsing each other, it is difficult to see how more than half the light can be cut off in each case, and the minima more than three quarters of a magnitude fainter than the maxima. It then becomes necessary to assume that the two bodies are of unequal brightness, that they are elongated, or that we have a single body of the shape of a dumb-bell. Some observers have found the minima two magnitudes fainter than the maxima. To account for this, we should be obliged to assume that one axis of the body was six times as long as that at right angles to it. Observations show that the light of Eros is continually varying, while if the case were that of a simple eclipse, as in the stars of the Algol type, we should expect that it would retain its full brightness for a large portion of the time.

If the bodies were of the same size, and the orbit circular, it might be impossible, from the light curve, to distinguish between the two hypotheses. The fourth of the corrections mentioned above, however, furnishes a means of distinguishing between them in any case. If the body is dark on one side, the time of revolution will equal the interval between the successive maxima, and the correction for the position of the observer will be proportional to this quantity. If then the position changes 180°, the correction will be one-half the interval between the successive maxima. In the second case, the time of revolution will be double this, that is, equal to the interval between a given maximum and the next but one, so that the correction for position will now be twice as great as before, and approximately equal to the interval between the successive maxima.

Much material already exists for determining this. Several of the photographs of Eros taken in 1893, 1894 and 1896 had an exposure of an hour or more. Owing to the motion of Eros, it formed a trail on each of these plates, which in some cases shows distinct variations in brightness. This was noticed when the plates were first examined, but was supposed to be due to changes in the haziness of the air. As this is an easy method of discovering the variability of an asteroid, it is hoped that astronomers engaged in a photographic search for such objects will examine carefully all trails, to detect any changes in intensity. An examination of forty-one asteroid trails photographed with the Bruce telescope, seven of them on a single plate, failed to show, except in one or two instances, any change beyond that apparently due to varying atmospheric absorption. Generally, more than one asteroid appeared on each plate, and in such cases all showed the same changes in intensity.

The photographs of Eros taken in 1893 and 1894 fail to show any marked variations in light, and it is probable that the range was, at the time, small. The plates taken during 1896 give more conclusive evidence of changes.

The photometric measures made in 1898 furnish an accurate determination of the times of maximum, and of the range for that epoch.

A very large number of photometric measures of Eros have been made since July, 1900. Observations have been obtained with the 15-inch equatorial on 51 nights, the number of photometric settings each night being, in general, 32, but sometimes more. It has also been observed on 56 nights with the 12-inch horizontal telescope, 32 or more settings being made each night. Some months will be required to reduce these observations completely, owing to delay in adopting magnitudes of the comparison stars.

The range of variation in the light of Eros, which has been diminishing during the spring, has now become zero.

EDWARD C. PICKERING.

Harvard College Observatory.

CULTIVATION OF RUBBER IN MEXICO.

BY ENOS BROWN.

A very large amount of Pacific coast capital has, within the past few years, been invested in the rubber plantations of the southern Mexican States. In years gone by the rubber industry of Mexico was of considerable importance, but the improvident native method of harvesting was fatal to the industry, and the large returns dwindled as the number of trees decreased, until the export of native rubber ceased to be of much account. The States of Tabasco and Chiapas, adjoining the isthmian region of Tehuantepec, have been the former sources of rubber supply. In soil, temperature, rainfall and other general conditions, these States possessed ideal qualifications for the cultivation of the tree. The soil is the accumulation of long centuries of tropical decay, while the annual rainfall ranges from 150 inches and upward. The temperature required, hot and humid, is here found, while the dense shade which the rubber tree is said to crave is afforded by the untouched forests which abound in the extended valleys of the watercourses of a labyrinth of navigable streams emptying into the Gulf of Mexico. The capability of these lands for the cultivation of the rubber tree has been remarked by consuls and travelers for many years, but the project seemed not to attract capital on account of their inaccessibility and the unhealthy nature of the occupation; but the increasing scarcity of supplies, accompanying the enormous increase of demand, has stimulated the investment of capital, until at the present time not less than 200,000 acres in the Tehuantepec provinces have been acquired, principally by Americans, who have invested $5,000,000 in planting and development.

The rubber tree responds quickly to intelligent care and cultivation, and thrives best in lands having an elevation above sea level of from 200 to 1,200 feet. It requires a rainfall of at least 100 inches in twelve months. The soil required must be rich and fertile. It is a rapid grower, like all "soft" wood trees, and in nine months has been known to attain a height of 9 feet 5 inches. In 6 years, sometimes in 5, the tree is ready to be tapped, and an average yield of 3 pounds of rubber is anticipated. At 7 years of age the tree yields 4 pounds, and at 8 years of age 5 pounds, increasing from year to year. A tree known to be 50 years old yielded 35 pounds of rubber in 1900. The companies have planted nurseries for raising the plant from the seed. It is estimated that 1,500,000 young trees are ready to be transplanted onto the cleared lands. Two hundred trees are planted to the acre. When planted they require no farther care, and in six years they begin to produce. It has been found that dense shade is not always a requisite, and cultivators find it an advantage to clear the lands to a great extent, affording more light to the growing trees, as well as a contingent profit in the marketing of mahogany and other valuable timbers which flourish in this region as nowhere else.

The principal difficulty so far met with is scarcity of labor. The natives are indolent and good-natured, but are constitutionally averse to hard labor. Arrangements have been consummated for the importation of a large contingent of Asiatics.

Throughout the State of Chiapas there are wonderful remains of monuments of a past civilization. Palenke, the capital of the ancient races who once swarmed over this region, possesses many types of ruins, covered with mysterious hieroglyphics, as yet undeciphered, which demonstrate the high standard of civilization to which these ancient people once attained.

Mr. J. W. Ellsworth, managing director of the Chiapas Rubber Plantation Company, who is now supervising planting and improvements on the property of the company, reports, in a communication dated March 21, 1901, on the growth and yield of trees grown in the district in which the company's plantation is located. The measurements were taken and the trees tapped during the month the report was made, under the personal supervision of the director, and with precautions that insured absolutely precise, accurate and reliable results, for the purpose of determining the probable yield and growth of the rubber tree under intelligent and careful cultivation, and with the conditions existing in the department of Palenke, State of Chiapas. It was found that trees five years of age had attained a diameter of from 8 to 10 inches, and yielded from 3½ to 4¼ pounds of pure rubber. Trees six years of age were 10 to 11 inches in diameter, yielded 4 to 5 pounds per tree, and from those trees seven years old, from 14 to 16 inches in diameter, the yield was 6½ to 8½ pounds per tree. All these trees were cultivated in partial shade. From those grown without shade the yield was materially less.

SCIENCE NOTES.

Herbert Spencer was eighty-one years old on April 27, and is in fair health. He has just completed a two-volume autobiography which will be published after his death.

A farmer in West Virginia has an elephant to do his plowing. He finds that the animal eats little more than a horse and does many times the work and is gentle and docile, so that the owner is well pleased with the experiment. A small circus broke up near the farmer's place, and its property was sold at auction and the elephant was purchased at a moderate price.

On June 30, 1900, there were 4,099 petty officers in the United States navy, of whom 57.3 per cent were native born, 33.6 per cent naturalized, 6.5 per cent had declared their intention of becoming naturalized, 1.5 per cent were aliens resident in the United States, and 9 per cent were non-resident aliens, while 90.9 per cent of the whole number were citizens of the United States.

In every street car in Leipzig are hung copies of a bi-weekly newspaper, containing advertisements of the railroad, time-tables, a few jokes, and notices of performances that are to be given at different theaters. The newspapers are fastened on racks which are hung upon hooks in the corners of the cars. Passengers have the privilege of taking the papers down and reading them.

It has been found that aluminium cooking utensils permit of greater fuel economy. This has been tested in the Madras Lunatic Asylum, where aluminium cooking utensils have been adopted. During six months of the last year before the introduction of aluminium vessels, the monthly weight of wood burned per head in cooking was 34 pounds. After the change the consumption fell to 19 pounds, a reduction of nearly 45 per cent.

Young Orris Benson, the deaf, dumb and blind rival of Helen Keller, has recently heard spoken words, and by a purely mechanical process has also been taught to speak many words and even sentences intelligently, so that he no longer admits that he is mute, and his teachers usually understand his spoken efforts readily. He is an expert typewriter, working the instrument rapidly and accurately. He uses the machine for all his written work.

A new plan having for its object the distribution of young trees throughout the country will be put into practical operation next year by the Secretary of Agriculture. An investigation has been made to discover the varieties which will thrive best in the various localities, and the distribution will be made in a manner somewhat similar to that employed in the seed distribution authorized by Congress. Special attention will be given to trees of the nut-bearing, shade, and lawn variety, and oaks. Ash and lindens will also constitute a prominent portion of the distribution. The Secretary believes that the idea will prove popular.

The Internal Revenue Bureau has prepared a statement showing the receipts, by items, resulting from the additional taxes imposed by the war revenue law. The figures cover the period from June 13, 1898, the date the law became effective, to February 28, 1901. The receipts were as follows: Schedule A, documentary stamps, $98,420,099; Schedule B, proprietary stamps, $12,784,694; tobacco, $42,405,859; beer, $89,154,822; special taxes, $14,026,359; snuff, $2,393,275; cigars, $8,291,608; cigarettes, $3,547,490; legacies, $6,889,055; excise tax, $2,398,823; mixed flour, $20,609; additional taxes on tobacco and beer, $978,816; total, $281,311,515.

M. L. Beulaygue has made some interesting experiments upon the influence of darkness on the development of flowers. He finds that flowers open in darkness later than in sunlight, and that the color of the flowers is in general less intense in darkness than in sunlight, the diminution of intensity being small for some species, while others lose nearly all their color. Flowers developed in darkness have, in general, a smaller size than those developed in the light, but, on the other hand, the pedicels are sometimes more fully developed. He also found that the weight and the size of flowers developed in darkness, including the pedicels which support them, are less than for flowers developed in sunlight, except in some rare cases where the increase of size of the peduncles counterbalances the diminution of the rest of the plant.

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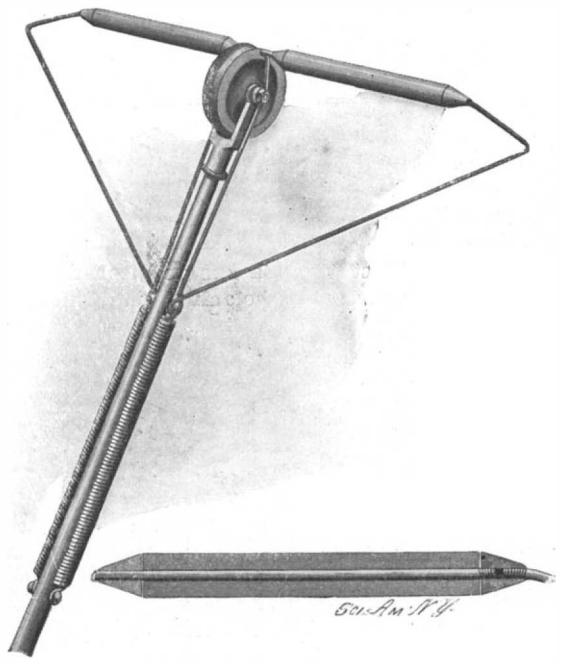
AN ATTACHMENT FOR TROLLEY POLES.

When an electric car rounds a curve, the trolley-pole often "jumps" the wire, thereby momentarily cutting out not only the motors, but also the lamp-current. In order to prevent this "jumping" of the trolley-pole, Mr. Willard P. Smith, of 56 Hudson Street, Manhattan, New York city, has devised the simple attachment shown in our illustrations.

At opposite sides of the trolley-pole guards are ar-



AN IMPROVED TROLLEY-POLE GUARD.

ranged, each comprising a vertical portion swinging on the trolley-bolt, a horizontal portion carrying a metal roller, and an inclined brace connecting the horizontal and vertical portions. An eye is formed at the lower end of each guard, which eye is connected with a coiled spring secured to the pole.

Should the trolley jump in turning a corner, the wire will come in contact with a roller, so that the motor and lamps will not be cut out. Should the wire run off the roller, the inclined brace will readily guide it back. The coil springs permit the guards to yield when the trolley runs off the wire.

A CONCRETE CHIMNEY.

BY RALPH C. DAVISON.

The increased use of concrete for building purposes has taken rapid strides within the last five or six years. No architect of the present day questions its durability. A series of experiments extending over a period of twenty years demonstrated that concrete grows harder as it grows older.

Thousands of dwellings have been built of concrete in England and Continental Europe. Of these, many, after more than half a century, prove their practical indestructibility.

A fine example of concrete work is that of the lighthouse at Port Said, which is 180 feet in height.

The reasons why this desirable material has not been more generally used are: First. The great compressive strength of concrete (the power to resist crushing) could not be utilized on account of its lack of tensional strength (the power to withstand a pulling strain). Second. Because there was a lack of efficient appliances for making and molding it.

The complete success of concrete construction to-day is due to the introduction of what is known as the "iron-concrete construction," or reinforced concrete. The basis of this system is a combination of iron and concrete; the iron is embedded in the concrete in such a manner as to give the concrete all the tensional strength of the iron, and at the same time to fully utilize the immense compressive strength inherent in the concrete.

The tensional strength of the steel or iron, which is about 30 tons to the square inch, increases the strength of the concrete about one hundred fold. Many different forms of iron are used in concrete construction, such as iron net, square iron bars, twisted iron bars, etc.

Concrete-iron construction is universal in its application, covering the entire field now occupied by stone, brick, and terra cotta, such as stairs, foundations, walls, floors, fortifications, sidewalks, etc.

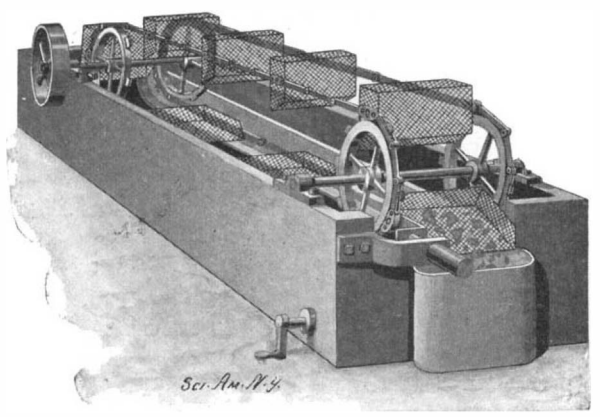
The advantages derived from using concrete are not only simplicity in construction, but the fire-resisting qualities of concrete are far superior to those of any other building material now in use.

A new departure in concrete construction is that of chimney-building. A concrete chimney has just been completed for the Singer Manufacturing Company at Elizabethport, N. J. This chimney is of the Ransom cold-twisted-iron construction, and is the second of its kind in this country; the first, a chimney 150 feet high, with walls less than 12 inches thick, was built about three years ago at Bayonne, N. J., for the Pacific Coast Borax Company. This chimney has given perfect satisfaction and has withstood a number of severe wind storms. All the buildings of this company are of concrete throughout. The Singer chimney is a straight chimney 125 feet high, with a 9-foot flue. It weighs 250 tons, the load on the base being 9½ tons to the square foot; 20 pounds per foot was allowed for wind pressure in designing the chimney. What is known by concrete men as "wet" concrete was used. By a wet mixture is meant one which quakes slightly when rammed; by dry mixture is meant one which requires repeated ramming to bring water to the surface. The concrete was mixed according to the following proportions: 1 part American Portland cement, 3 parts sand, 5 parts broken Hudson River limestone. (Stone broken to pass through a ¾-inch ring unscreened.) All of the concrete used was machine mixed, this process being much quicker and cheaper than mixing by hand. The method used in constructing this style of chimney is ingenious and novel, and is covered by patents. In laying the foundation for this chimney no piles were used; the ground was simply leveled off and the concrete laid as shown in Fig. 1. Cold-twisted iron bars were embedded in the foundation, radiating from the center, as shown. Twisted rectangular bars are used for the reason that the spiral ribs formed upon the iron make a continuous lock between the bars and the concrete. It was also shown by test that the tensile strength of twisted bars was considerably more than bars that were not twisted. The following table shows the increase of

Material.	No. of twists per foot.	Per cent of gain.	No. of twists per foot.	Per cent. of gain.
¾ inch square commercial iron	¾	0.03	¾	0.05
" " " "	1½	0.17	2¼	0.18
" " " "	3¾	0.20	6	0.24
¾ " " Norway "	....	....	6	0.53

strength of iron bars by reason of twisting. When the foundation is thoroughly set, a mold is put in place and the actual building of the chimney commences. This mold is constructed as shown in Fig. 2. It is filled with concrete, through which iron bars are distributed as shown in Fig. 1. This concrete is then thoroughly tamped and allowed to set. It will be noticed that the chimney has an inner and outer shell; the space between these shells is obtained by means of wooden core blocks. Scaffolding is erected inside of the mold; on this scaffolding the hoisting beams, *A*, shown in Fig. 2, are supported.

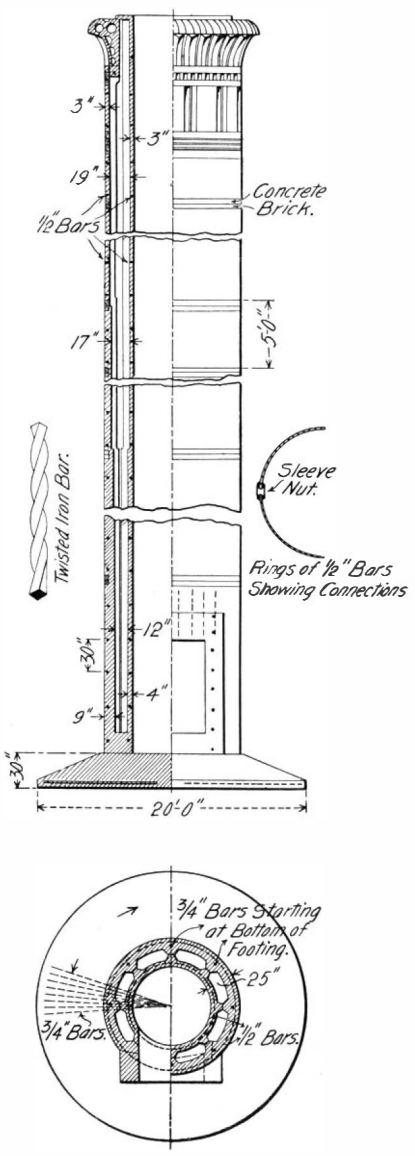
After the first filling of concrete in the mold is thoroughly set, the turnbuckles on the mold are let out, leaving the mold free to be raised by means of the threaded stays and hand wheels. Eight men are required to raise the mold, one man at each wheel. The mold is raised 5 feet at a time, this leaving the mold a lap of 7 feet on the portion of the chimney already set. The mold is now tightened up by means of the turnbuckles, and is again filled with concrete



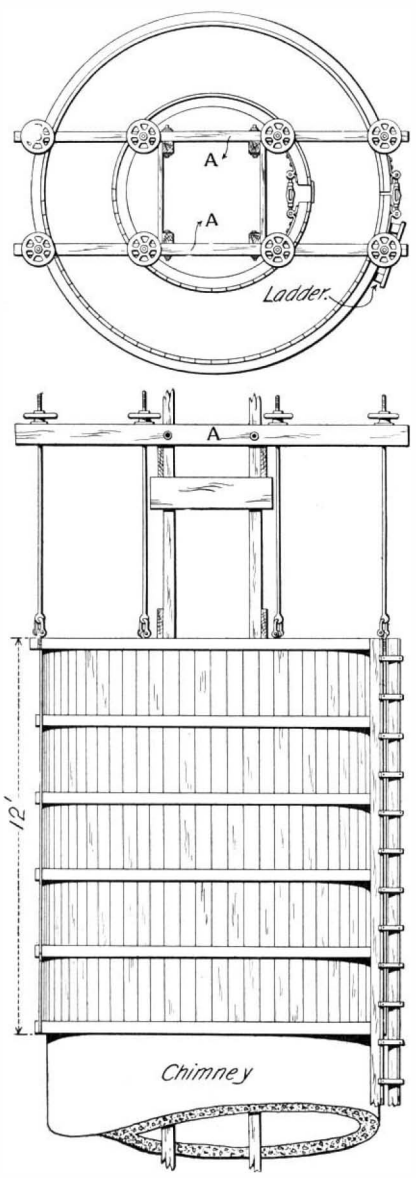
A NEW ICE CONVEYING APPARATUS.

and iron rings. Perpendicular iron rods are also placed through the chimney, as shown in Fig. 1. These are joined at every filling, making a series of continuous bars from the base to the top of the chimney. The operation is continued each succeeding day, the scaffolding being extended upward, and the mold raised, filled and the concrete allowed to set; thus 5 feet of the chimney is completed each day. When the mold is raised high enough to clear the cleaning-out door, the concrete is delivered to the men on the scaffolding by means of a bucket-hoist inside of the mold. In molding the cap, a plaster mold is used.

The outside finish of these chimneys may be left plain, or tooled to represent stone; sometimes, to add to a chimney's appearance, two rows of concrete brick are laid in place after each day's work, this making a series of brick rings 5 feet apart throughout the height of the chimney. When lightning rods are desired, the perpendicular rods already referred to are extended up through the cap.



DETAILS OF CONCRETE CHIMNEY AT ELIZABETHPORT, N. J.



PLAN AND ELEVATION OF THE MOLD.

A NEW ICE-CONVEYING APPARATUS

In regeling ice-machines, the ice-particles or chips are turned off from the freezing cylinder and are considered cold enough to freeze together when collected and compressed.

Usually the ice-particles, however, are greatly agitated in the water before being discharged into the suction-pipe or solidifying device, and their temperature becomes too nearly that of the water, so that in a completed cake of ice some films of water sink down, drawing in air, and marring the appearance of the cake. To overcome these objections and to provide an improved means for collecting and discharging the ice-particles with least agitation, so that the final cake will be more thoroughly frozen and solidified, is the purpose of an invention patented by Ambrose H. Rauch, of Bethlehem, Penn.

In the freezing-tank which forms part of the apparatus for making ice by the regealing method, and from which chips or particles of floating ice are discharged into a suction-pipe leading to a slush-pump, Mr. Rauch mounts a skimming mechanism. The essential features of this mechanism are scoops mounted to swing on two endless carrier-chains passing over sprocket-wheels. Each scoop consists of a metal frame with bottom, back and sides of screen material through which the water may pass freely.

The scoops pass down between the one set of sprockets in a vertical position, and, while moving through the water in the tank, are turned to a horizontal position to gather up the ice-particles, by means of guide-rails.

At the outlet end of the tank is a spring-actuated hammer designed to be engaged by a scoop, or by one of its trunnions, when the scoop is about to discharge its load. The trunnion of a scoop gradually compresses the spring of the hammer until the scoop is about to discharge its contents. Then, when released, the upper short portion of the hammer strikes the trunnion, thus jarring the ice-particles into the pipe.

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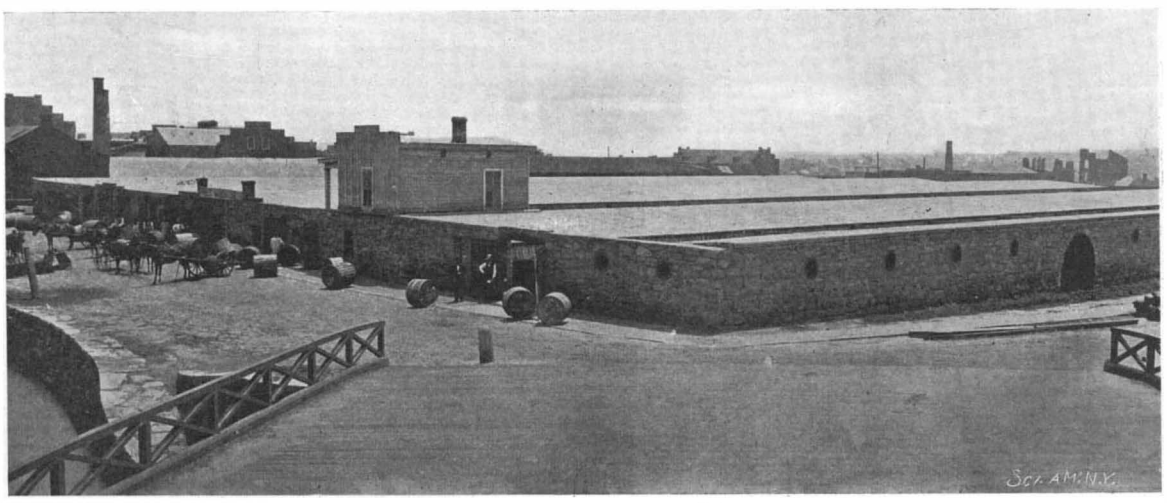
THE TOBACCO INDUSTRY.

BY WALDON FAWCETT.

A new impetus has been given in recent years to the tobacco industry in the United States—ever one of the lines of enterprise most largely contributory to the material prosperity of the country. There can be no doubt but that these new conditions have been induced in part by the very extensive investigations relative to this plant which have been carried on during the past three years by the Division of Soils of the Department of Agriculture. A systematic study has been made of all the diseases of the crop, and the very important discovery has been made that the ever-troublesome fermentation is not caused by bacteria, as had always been supposed, but by chemical ferments produced by the tobacco plant itself. This discovery has suggested important modifications of the old methods of handling tobacco which promise much improvement in leaf tobacco, and will unquestionably be the means of adding millions of dollars to the wealth of the country. Tobacco was grown in this country long before the arrival of the first settlers, and served as legal tender during the early days of the colonies. However, the beginning of the last century found only the dark export types of Virginia and the light pipe-smoking tobacco of Maryland grown to any extent, and it has been within the century which has just closed that the cigar, lemon-yellow cigarette, mahogany manufacturing, Burley and Perique classes have been developed.

Even during the earlier years of the century, wherein the tobacco industry made such advancement, the rate of progress was slow. It was only when foreign consumers made an imperative demand for colored tobaccos that the utilization of artificial heat for curing was introduced. During the first quarter of the century wood fires were the only artificial means employed for curing tobacco. Then flues and charcoal fires were introduced; but it was not until after the civil war that flue curing entirely superseded charcoal fires in the production of the bright yellow varieties now used for cigarette, plug and twist wrappers.



OLD TOBACCO WAREHOUSE, RICHMOND, VIRGINIA.

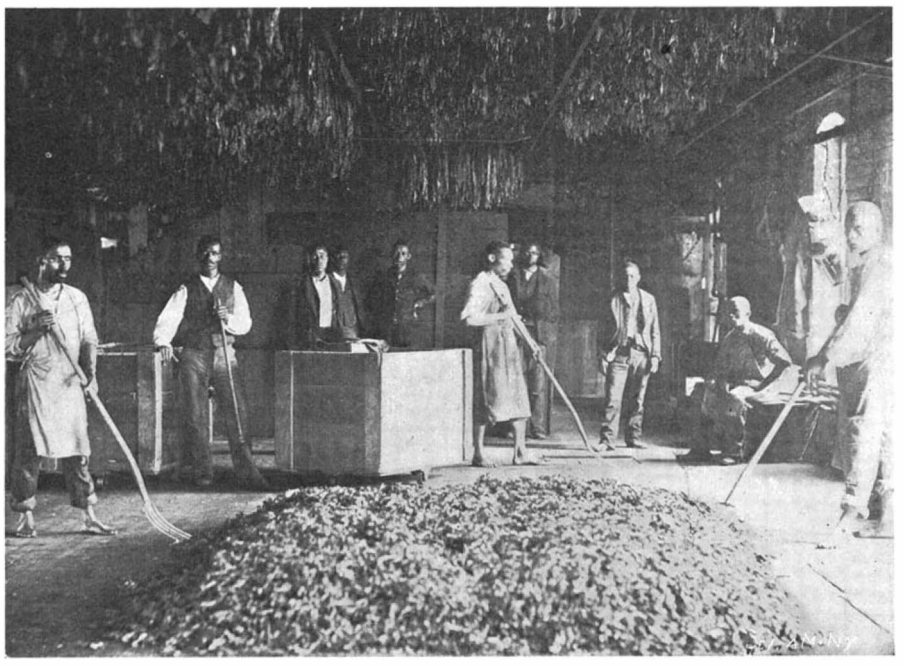
The States of Virginia and Maryland constituted the original seat of the tobacco industry. New England settlers attempted to cultivate it; but the first real extension of the industry was westward into Kentucky and Tennessee. The first crop of lemon-yellow tobacco was produced in 1852 on a sandy ridge in Caswell County, North Carolina, and the variety attained to such popularity that its cultivation spread rapidly, until the outbreak of the civil war, which conflict, of course, interrupted the culture for half a decade. In 1864 the White Burley tobacco was originated, and by reason of the absorbent powers of the leaf proved particularly well adapted for wrappers.

All the principal nations of the world purchase considerable quantities of tobacco from the United States. It is significant that each country differs in its requirements and in the character of the leaf used. Inasmuch as all the various countries are supplied from the same section of the country, and the differences in the tobaccos would appear to a casual observer to be very slight, considerable experience is required on the part of a packer to assort the various tobaccos into the grades suitable for each country, and to put the weed in the condition required by the particular country to which it is to be consigned.

These differences are, however, real and not imaginary as some persons might be inclined to suppose. For instance, Great Britain, which requires the best leaf and pays the highest price, demands a large leaf, olive green in color and so heavily smoked in curing that the odor of wood is apparent in the leaf. Africa, on the other hand, takes a long narrow leaf of heavy body, which is made very black by steaming and packing under heavy pressure in the hogshead while the tobacco is still warm. Oil is applied by means of a sponge to each layer as it is packed.

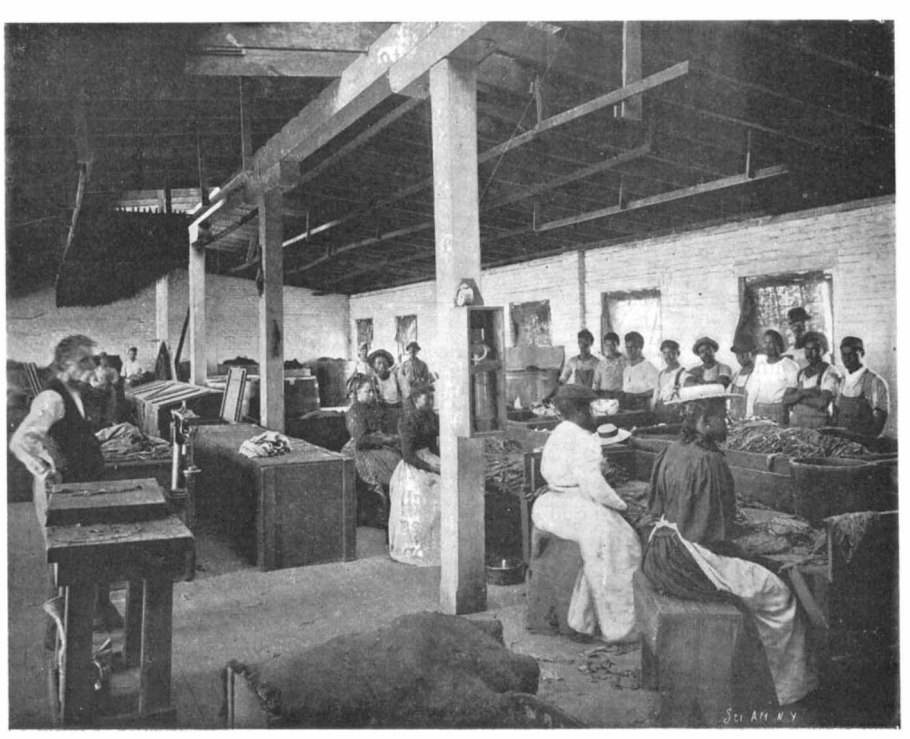
The curing of all the dark export tobaccos is effected by open hardwood fires. The Virginia tobacco is, generally speaking, somewhat superior to the yield from Kentucky and Tennessee, and consequently most of it is retained by the manufacturers in this country. The tobacco farmer usually assorts his harvest into "lugs," "good leaves," and "top leaves," but the

CUTTING TOBACCO LEAVES.



DRYING TOBACCO IN A WAREHOUSE.

STRIPPING TOBACCO LEAVES.



WRAPPING ROOM—CIGAR FACTORY.

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final grading and treatment are left to the determination of the packer, who decides into which country each quality of tobacco shall be sent. The light tobaccos used exclusively for pipe smoking and cigarettes are produced principally in Maryland and Ohio. That grown in the former State is air-cured, while the Ohio product is cured by means of wood fires.

The agents of foreign countries who buy so many million dollars' worth of tobacco in this country purchase entirely by sample. The tobacco goes from the plantation to a large warehouse established for the inspection of the goods by State officers. When the tobaccos have been entered in the warehouse, a sworn and bonded inspector draws four samples from each hogshead, taken from different places and at equal distances apart, beginning near the bottom of the hogshead. These samples are tied together and after being sealed are labeled with the name of the owner, the number of the hogshead, the net and gross weight. When a hogshead is forwarded to a foreign purchaser the sample accompanies it, and if there be more than ten per cent of the tobacco in the hogshead poorer than the sample, the inspector, who is under bond, becomes liable for the difference.

Tobacco ordinarily grows from three to fourteen feet in height, according to climate and other conditions. The first step in its culture is the preparation of the seed bed, which in the South is done in January. Before the seeds are sown the ground is burned over in order to kill all foreign seeds and also produce an ash that acts as a fertilizer. The young plants when they attain to a prescribed growth are transplanted to hills in the field, where, after they have ripened, the entire plant is cut close to the ground.

The leaves go from the field direct to the curing house, where they are placed upon frames. Perhaps half a ton of tobacco is cured simultaneously, the process occupying some four or five days, and during this interval the leaves are kept in a temperature which is seldom below one hundred degrees and for hours at a time is nearly two hundred degrees. Then comes the packing according to the market for which the product is destined, as has already been mentioned.

The manufacture of cigars was begun in a small way in the United States in 1801, and the first factory was established about nine years later. At first the cigars were peddled about the country in wagons; but the demand increased rapidly. Just prior to the civil war the annual production of cigars in America was less than one-fifth of a billion. In 1875 it was nearly two billion, and in 1892 four and a half billion. The increase since that time has been even more rapid. The manufacture of cigarettes began during the civil war and gradually increased until several billion now constitutes the annual production. It was during the civil war, too, that the first governmental tax on the various manufactured forms of tobacco was imposed, although dealers and manufacturers were not required to take out licenses until several years later.

Formerly girls were employed extensively in the manufacture of cigarettes, but now the work is performed almost exclusively by machine. The cigar consists of three distinct parts, the wrapper and underneath that the binder, both of leaf tobacco, and the "filler," constituting about one-half the weight, of cuttings or fine shavings of the leaf. The cigar-maker rolls the filling rather loosely, and does not attempt to give it much shape until the binder has been wrapped around it. The outer wrapper is of course put on with considerable care, and then the cigar is trimmed to the proper length and placed in the bundle or box wherein it goes to market.

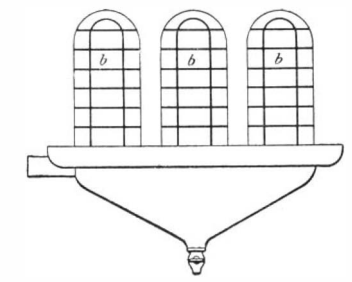
The portion of the population of the United States directly or indirectly dependent upon the tobacco industry would form a city considerably larger than Boston or Baltimore, and the annual wage paid to employes of the tobacco industries amounts to much more than the aggregate deposits of the three largest savings banks in the country. For half a decade past the exports of American tobacco to all countries have averaged 140,000 tons annually, valued at upward of $24,000,000.

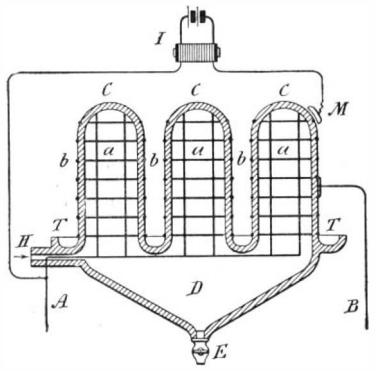
Christmas Island.

Sir John Murray, the eminent English explorer, has recently returned from a six months' expedition to Christmas Island, a small islet twelve miles in length by six miles in width, situated in the Indian Ocean, about 220 miles from land. The island is in reality a dense forest, but is famous for its rich phosphate deposits, the working of which constitutes the staple industry of the colony. The population comprises thirteen whites, including a doctor, chemist, and engineer, with their families, and 720 Indian coolies, all engaged in the phosphate mines. There is no anchorage, but a splendid open roadstead, and the depth of the water round the island varies from three to four miles. The most interesting features of the island are the animals and plants. The place is overrun with a curious red crab, specimens of which were discovered measuring about eighteen inches across the back. The most salient characteristic about them is that they are excellent tree climbers, and regularly once a year they migrate from the trees in one huge colony, like ants, to the sea to hatch their eggs, after which they return inland, the whole journey occupying about fifteen days. Sir John only discovered two mammals upon the island, which were species of rats hitherto unknown. One, which infests the coasts, is black in color, while the other, indigenous to the inland plateau, is brown. They are so abundant that a number of terriers have been imported with a view to their extermination. Sir John Murray experienced considerable trouble in piercing the forests to the central plateau, which is some 1,000 feet above sea level, owing to the prolific and thick growth of the vegetation. One night he lost his way and had to subsist upon the tops of sago palms. An administrative body has recently been dispatched to the island, and buildings for the public business are to be erected. The climate is perfect, resembling a hot English summer. Prior to the British annexation the island was uninhabited.

NEW GAS BATTERY.

A new gas battery has been lately devised by a German inventor, Andrew Plecher, which presents some interesting peculiarities. The electromotive force is produced by the combination of hydrogen and oxygen, this being brought about by using the well-known properties of finely divided platinum. The diagrams show the section and exterior view of this battery, which consists of a series of chambers, *C*, made of a specially prepared material; for this purpose a mixture of clay or plaster with a solution of





NEW GAS BATTERY.

chloride of platinum is generally used. The vessels are dried and then baked so as to harden the material and decompose the platinum salt, when the metal assumes a finely divided state. In the interior of the vessel is a system of conductors, *a*, formed by rods or wires attached to the walls; the conductors of all the vessels are connected to a common terminal, *A*. On the exterior of the vessels is placed a similar system, *b*, connected to the terminal, *B*. The vessels rest upon a lower portion, *D*, with inclined walls, and having at the bottom an escape-cock, *E*. At the side is an opening, *H*, for the admission of the gas. The battery is put in action by introducing hydrogen by this opening, the battery being filled with the gas, while the oxygen at the exterior is furnished by the surrounding air. The two gases penetrate into the porous walls of the vessel and combine under the influence of the finely divided metal; water is formed by this combination, and this runs down the sides of the interior and is taken out at the bottom, while that formed at the exterior of the vessels is collected in a trough, *T*, surrounding these. This combination of the gases sets up an electromotive force between the terminals, *A* and *B*. It has been found that the combination of the gases may be increased by the action of an induction coil, *I*, whose secondary circuit is connected to the terminal, *A*, on the one hand, and on the other to an exterior conductor, *M*, placed at a short distance from the walls of the vessel. In this battery no electrolyte is needed; it is even best to get rid of the water as much as possible, and its evaporation may be hastened by a current of air. Palladium may be used instead of platinum, as its action is similar in this respect. The action is not confined to hydrogen and oxygen, but other gases may be used.

The chimes of St. Patrick's Cathedral, New York city, are now rung by compressed air, the bells being actuated through the medium of electrical devices.

Automobile News.

There are at present 170 automobiles in use in the city of Brussels.

The Austrian military authorities have been experimenting for two years on the value of automobiles for conveying stores and ammunition, and they now intend to test the possibilities of transporting troops at this year's maneuvers.

The firm of Panhard & Levassor has come to America to obtain a sparker for the engines of their carriages. We refer to the auto-sparker made by the Motsinger Device Manufacturing Company, of Pendleton, Ind. One of the machines was sent over to France, and after exhaustive tests it was decided to adopt the auto-sparker, and the French patent was purchased. This is, we believe, the first instance where makers of motor carriages abroad, especially in France, where the industry may be said to have originated, have turned to America to obtain one of the most important parts for the construction of their vehicles, and it also shows how essential it is to take out French patents on mechanical devices of this nature.

A series of tests has been made on the tracks of the Northern Railroad, in France, with a new type of automobile passenger car. It has been built by Panhard & Levassor, and has a 4 horse power motor of the petroleum type. Two seats run along each side, accommodating 20 persons, and the conductor's place is in the middle, toward the front. The motor, placed in the front of the car, is thrown into gear by a clutch operated by a foot-lever, while a hand-wheel gives four speeds of 7, 11, 15, and 22 miles an hour. As the car is built to run upon the railroad track, the differential is naturally suppressed, and this has led to some other changes in the mechanism, especially that of the forward and reverse movement. The whole is now controlled from the same hand-wheel, and arrows indicate the direction of movement. The refrigerating tubes are placed upon the roof. This car is to be sent to Algeria and will be put in service over a section of narrow-gage railroad.

A service of motor omnibuses has been established in London. The company responsible for this energetic step is the Southwestern Motor Company, and the vehicles will ply through Batham, Streatham, Tooting, and Wandsworth, the most densely populated southwestern suburbs of the metropolis. Locomotion between these points and the City is very inadequate, so that probably the public will appreciate the new means of transit. The preliminary service consists of four cars which will travel at a maximum speed of twelve miles an hour. If the enterprise is successful other vehicles will be added, but since motor locomotion in London hitherto has been attended with failure, it was decided to carry out the experiment on a small scale. The vehicles are of the covered wagonette type with accommodation for eight passengers inside and two on the box seat with the driver. The sides are removable, so that in hot weather the cars will be quite open. They are handsomely finished in natural wood and run on broad rubber-tired wheels. The fare is two cents per mile at present, but if the enterprise is successful probably the tariff will be reduced.

The Chauffeur contains an interesting account of the automobile situation in Madagascar. There are few colonies where the automobile seems better adapted than Madagascar. The conditions in this country are somewhat special; on the one hand, the intelligence of the natives is considerably above the average, and on the other the capital, Tananarive, is situated in the center of the island, and united only by roads to its two supply-ports, Majunga and Tamatave. An automobile system between the first-mentioned town and the capital will soon be in operation, and the second line, from Tamatave to Tananarive, will shortly follow. For the latter, six of the most skillful operators from the Paris factories are about to start for the island with six machines of the Geo. Richard and Panhard types. These men will organize the system and train the natives to conduct the machines and keep them in order. It is proposed to run them with alcohol obtained from cane-sugar. In the first enterprise, under a French company, the machines are of the Panhard and De Dietrich makes; for these gasoline is to be used, but some trouble is expected on account of the rapid evaporation due to the heat. The second enterprise is headed by a native of Madagascar. It is proposed also to try the Koch automobiles, which use ordinary petroleum, upon both these systems. The roads, as it appears, are very fair, but one difficulty is experienced on account of the bridges, as at present these are made by trunks of trees bound together and thrown across the streams. Passengers and freight are now transported by native carriers, and the cost is naturally very high. Under these conditions any great amount of traffic with Tananarive would be impossible. The use of the automobile is therefore quite in order, and the result of the trials will be followed with interest. These are to be reported from time to time by the conductors in charge.

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MANUFACTURE OF PLATE GLASS.

Among the numerous branches of manufacture which have made Pittsburg and the valleys of the Allegheny and the Monongahela the most famous industrial center in the world, the manufacture of glass in its various forms hold a prominent place. The subject of our front page engraving is the Charleroi plant of the Pittsburg Plate Glass Company—one of ten different establishments which are controlled by that great organization. The plant as here described is thoroughly up-to-date, and may be taken as illustrative of the latest processes in this industry.

The raw materials for the glass consist of sand, salt cake, soda ash, limestone, charcoal and arsenic. These are brought to the works on cars, which are run up on to a trestle that extends above a series of bins in the storage house. The various materials are dumped into their respective bins, from which they are shoveled, in the proper portions, into two-wheeled hand-carts, known as "batch wagons," and wheeled to the weighing machines, where the proper proportions of each constituent are determined by weight. The material is then thoroughly mixed, and wheeled to the casting-hall furnaces. Over 50 per cent of the mixture consists of sand, the grade of sand used in the manufacture of plate glass being an almost pure silica.

THE MELTING POTS.—The melting of the mixture is done in large clay pots which are 44 inches in diameter and 3 feet deep. As these pots have to be exposed to a fierce heat of nearly 3,000 degrees, the greatest care has to be taken in the selection and preparation of the clay from which they are molded. The "pot-clay," as it is called, is somewhat similar to firebrick clay; but it has to undergo a most careful and thorough kneading by foot in order to give it the proper consistency and the remarkable tenacity which is one of its chief characteristics. The kneading is done in a large square vat by specially trained workmen, who tramp sideways from end to end of the vat, stamping down the clay as they go. A poorer grade of the same clay is prepared for manufacturing the furnace doors. After kneading, the clay is taken to a room above, where the pots are carefully molded by hand, the molders building up the circular wall of the pot by working in a handful of the clay at a time, each lump being thoroughly kneaded into the piece as it grows into shape. The walls of the pot are 4½ inches thick. After the pot is completed it is left to dry by natural heat. The furnaces are arranged as shown in our engravings. The bottom of the furnace is level with the floor of the furnace room, and each furnace has ten vertically sliding doors, five on each side. The whole structure is built of first-class firebrick, the sliding doors consisting of large molded slabs of clay. In this particular works there are five of these furnaces, three of which are in continual operation, the others being held in reserve.

MELTING AND CASTING.—After the mixture of sand, salt cake, soda ash, etc., has been placed in the melting pot, it is picked up by a mammoth pair of tongs, brought by an overhead traveling crane to the furnace and placed on the floor of the same. After the doors are closed and sealed, the producer-gas is turned on, and in fifteen hours the mixture is melted ready for pouring. The door is then lifted and a large, wrought iron, balanced, pair of tongs is swung into the furnace by a traveling crane. The pot is withdrawn and brought to the casting table, a view of which is shown in our lower front-page engraving. The casting table is a carefully-trued surface of cast iron, and travels on a track laid between two lines of annealing furnaces. Upon one end of the table is a hollow cast iron roller 18 inches in diameter, which extends entirely across the table. Down each edge of the table is laid a strip of iron, half an inch in thickness, upon which the roller travels. Around each end of the roller is wound a chain, which is carried to the opposite end of the table, to the drum of a hand-winch. For convenience of operation the melting furnaces and the annealing furnaces are laid out at right angles to each other, intersecting at their common center. An overhead electrical crane carries the pot of molten glass up to the line of the annealing furnaces where it is set down and picked up by a small jib locomotive crane, which travels on a track that runs the full length of the annealing furnaces as shown. By this crane it is carried to the casting table, where the contents of the pot are poured out immediately in front of the roller already referred to. The roller is then drawn forward, and as it is raised above the table by just a half inch, or the thickness of the side strips upon which it travels, it follows that the molten glass is rolled out in a sheet of just that thickness. By the time it has been rolled out the glass has cooled sufficiently to be moved, and the door of the annealing furnace is raised and the sheet pushed forward into the furnace.

ANNEALING.—The object of annealing is exactly the same as that of annealing in the manufacture of steel; namely, to take out any cooling strains which may have been set up in casting, and to allow the molecules to rearrange themselves and take up a position which will leave the plate absolutely free from initial strains. The annealing furnace is heated to the proper temperature, about a cherry red, and as soon as the plate has been introduced the gas is shut off and the plate is left in the furnace for from four to five days.

GRINDING.—The glass plate as taken from the annealing furnace is half an inch in thickness, and it now has to undergo the grinding and polishing processes, during which it will be reduced to the finished thickness of a quarter of an inch, an eighth of an inch being lost on each side of the plate. The rough grinding is done between series of grinding tables arranged in groups of three, each group consisting of a lower and two upper tables. The lower table is a large cast iron rotating disk which has been faced and carefully trued up. The plate is laid upon this and secured to it with plaster of Paris. Bearing upon the glass plate are two circular runners, one of which is 12 feet and the other 14 feet in diameter. The two runners are journaled in a trussed frame which extends across the top of the machine, and they are driven by means of miter gears and shafting. The bottom face of the runners is shod with a number of parallel, cast iron, serrated bars, which are spaced about 3 inches apart. The grinding is started at a slow speed, the runners moving at the rate of about two revolutions to the minute. As it proceeds, the speed is increased until it reaches a speed of 30 revolutions to the minute. Sharp river sand and water are fed to the plate, and as not merely the runners, but the table below, are constantly rotating, the grinding is perfectly even over the whole surface of the glass, and a remarkably true surface is secured. When about an eighth of an inch has been taken off, the plate is turned over and the rough grinding is repeated on the opposite side. As the sand and water flows from the grinders it is carried to a series of pits and boxes where it is graded into four grades.

POLISHING.—The plate as it comes from the rough grinders is somewhat opaque and its surface has a milky appearance. It is now necessary to give it a finish polishing, which is done in a separate room upon a large number of low tables of the kind shown in our engraving. Down the full length of each table extends a stout cast iron girder, to which is attached at intervals of about 20 inches a series of transverse wrought iron bars. Through the end of each of these bars extend the vertical shafts of a series of felt-covered polishing disks. The pressure upon these disks is regulated by means of cup-shaped weights which are placed upon their vertical spindles. The polishers are fed with a rouge which is somewhat similar to the polishing rouge of jewelers, but is of coarser consistency. The longitudinal girders before referred to are connected to the crank-arm of a series of spur wheels driven, in each case, by a 75 horse power engine, and by this means an oscillatory movement is given to the whole series of polishers. It takes about 12 hours, 6 hours to each side, to give the proper finish polish to a plate of glass. When the polishing is completed, the plates are stamped and taken to the salesroom, where they are carefully examined by experts both for finish and quality. Any faults, such as small bubbles, unmelted portions of the original mixture that may have come through the process, scratches, etc., are cut out, or, if it is necessary, the whole plate condemned. The capacity of the Charleroi works is about 3,000,000 feet of finished glass per annum. The total capacity of plate glass by the whole ten establishments of the Pittsburg Plate Glass Company is 22,000,000 feet per annum.

The Marconi Patents.

Marconi's patents have been declared valid in the suits brought against the Anglo-Italian inventor by the owner of the Dolbear patents for a mode of electrical transmission without wires. The suit was brought in the United States Circuit Court, Judge Alfred C. Coxe presiding; damages of $100,000 were asked for. Marconi's answer was that his apparatus was an original invention and did not infringe on the Dolbear patent rights. He had two expert witnesses—Dr. J. A. Fleming, of London, and Prof. C. R. Cross, of the Massachusetts Institute of Technology. Dr. Fleming in his testimony, which was made in the form of a deposition, said that he had tried the Dolbear patent instruction, and he had failed to obtain any such signals or effects as described therein. No evidence was heard on the side of the plaintiff. The suit was dismissed, and the assignee did not wish to offer any testimony, it being claimed that the plaintiff had decided that wireless telegraphy without selective arrangements had no commercial value.

We regret to note the death of John Charter, Sr., the inventor of the Charter gas engine, who died at his home, at Sterling, Ill., on April 30. He was born in Freiberg, Germany, in 1838, and came to America in 1844, settling in Pennsylvania. In 1882 he invented the Charter gas engine, which was the first engine of its kind in the world to use gasoline direct.

Electrical Notes.

There are 150 miles of electric railways in Spain, of which Madrid has 16 miles.

Minister Smith reports from Monrovia, February 26, 1901, that Mr. T. J. R. Faulkner, a civil engineer from the United States, has placed that city in telephonic communication with White Plains, a settlement 25 miles up the St. Paul's River. This is the longest line in the country.

There seems to be an opening for electric fire pumps in many of our large towns. They could be transported to the scene of the conflagration and power can readily be obtained from the trolley wires. The engines might either run on the rails or be drawn by horses, or they might be provided with storage batteries and run as automobiles.

The Lexington Avenue Line of the Metropolitan Street Railway Company of New York is now operated by electricity as far as Twenty-third Street and Broadway, the road having been converted on May 6; and May 11 the cable service on the Columbus Avenue Line will be replaced by electricty, and a similar change will be made on the Broadway system on May 18. There will then be no cable lines in operation in Manhattan.

At the Buffalo Exhibition visitors will have the opportunity of seeing a small building made of aluminium. Niagara Falls is the principal aluminium manufacturing place in the world, and the white metal is a product of two principal factories located there, current being taken from both of the great power companies. This structure will be octagonal, and it will be as large as can be built in a space 15 feet square. The height will be about 22 feet, and it will be made of No. 24 sheet.

The Navy Department has been giving careful attention for some time to the subject of wireless telegraphy with a view of ascertaining how far it can be practically applied to the naval service. The subject has now advanced to a point where Secretary Long has appointed a special board of officers to make a thorough inquiry concerning it. The meeting of these officers will take place at Newport, and it is expected that their conclusions will determine to what extent the wireless system can be utilized for the navy.

Consul-General Guenther, of Frankfort, says that the captain of a channel mail steamer, which is equipped with an apparatus for wireless telegraphy, reports that on his last trip a message was received from the French light-ship, which is anchored about 25 sea miles from Dunkirk, stating that the latter would be unable to light up the next night unless help arrived from shore. The captain at once sent a second wireless message to La Panne, on the Belgian coast, from which point it was forwarded to Dunkirk by the regular telegraph line. From this place a boat was dispatched to the light-ship and the necessary repairs were made.

Consul-General Bittinger, of Montreal, under date of April 11, 1901, says that there are 102½ miles of electric road in that city; as motor power, there are available six engines of 600 horse power each, one engine of 3,000 horse power, twelve 200-kilowatt generators, six 300-kilowatt generators, and one 1,500-kilowatt generator. The rolling stock consists of 372 closed and 370 open cars. The company's capital at present is $5,500,000 paid up. In 1900, the company carried 43,362,262 passengers. Last year's business showed a net profit of $647,246.64, as compared with $630,870.61 for the year 1899. The above does not include the suburban roads.

Consul Jones, of Funchal, March 2, 1901, says that the Eastern Telegraph Company has just finished laying a cable from Falmouth to St. Vincent, Cape Verde Islands. It passes through the office of the Western Telegraph Company, Limited, at Funchal, and is worked in connection with the Cape-St. Helena route. The latter company has landed four cables at Funchal—two to Lisbon and two to St. Vincent. One of the Lisbon cables is continued to Brazil and connects that country with Europe. The direct cable route from Funchal to the United States, adds the consul, is via Lisbon and the Azores. The tariff to New York is about 50 cents per word.

The illumination of a clock face is undoubtedly an important business, and it is a matter for surprise, now that the electric light is obtainable in so many quarters, that progress in this direction has not been more rapid. As pointed out by Mr. A. A. Johnston in a paper on this subject before the Society of Arts, gas is the worst form of illuminant for the illumination of clocks. It corrodes the works, smokes and discolors the glass, dries up the oil, and is altogether most unsuitable. Lamps are preferable to gaslight, but the advantages of the electric light over all others for this purpose must be generally admitted. One advantage not specifically mentioned by Mr. Johnston, says the English Electrical World, is the ease with which the illumination of the dial can be made automatic when electricity is the lighting agent.

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THE MASTODON AT THE BROOKLYN INSTITUTE MUSEUM.

BY PROF. ALFRED G. MAYER.

During the summer of 1899 a skeleton of *Mastodon giganteus* was found upon the farm of Frederick W. Schaeffer, at Newburg, N. Y. This skeleton was purchased by members of the board of trustees of the Brooklyn Institute Museum, and is now mounted and on public exhibition at the Museum building, on Eastern Parkway, Brooklyn.

The skeleton is almost complete, so far as the trunk is concerned, but most of the leg-bones were not found. These have been replaced in plaster or from other mastodon bones.

The skeleton was found about four to six feet below the surface, lying upon the clay bottom of what had been a small pool of water. After the death of the mastodon this pool became partially filled with a layer of peat, having a maximum thickness of about three and one-half feet. Numerous sticks gnawed by beavers were found scattered through this peat, showing that the beavers had lived there long after the death of the mastodon. The peat was covered with a layer of clay and of black loam about two and a half feet in thickness.

There is some reason to suppose that the Brooklyn mastodon died long after the glacial period, but a careful examination of the locality must be carried out by some competent physiographical geologist before any statement to this effect can be made with certainty. The Brooklyn mastodon was an adult individual, and is peculiar in that the tusks curve upward and inward, their outer points being not more than eight inches apart.

In most mastodon skeletons it will be remembered that the tusks bend outward. There are no traces of tusks having been present in the lower jaw. Such tusks are seen in young mastodons, but they were shed at maturity by the females and occasionally replaced by a permanent tusk on the left side in the males.

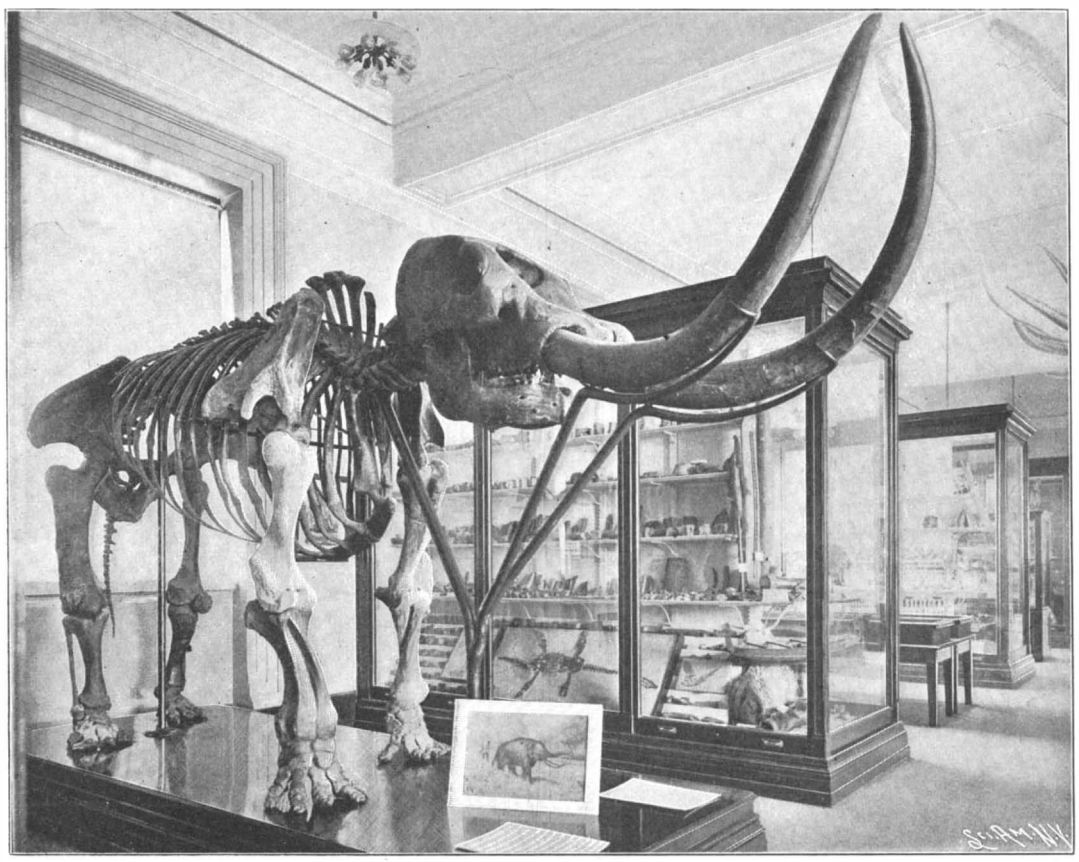
The mastodon was common from Mid-Tertiary times until near the close of the glacial epoch, over the United States, from the Gulf of Mexico northward and from the west banks of the Hudson River to the Mississippi Valley.

It was rare to the eastward of the Hudson, and this river probably proved a barrier to its migrations.

Several good skeletons have been found at Newburg, where they appear to have become mired in soft swampy ground. There is reason to believe that the animal fed upon the twigs and leaves of trees, for half-digested spruce twigs were found in the midst of the ribs of one of the Newburg mastodons.

The mastodon probably presented the appearance of a huge hairy elephant having remarkably long, massive tusks. Although we have no direct evidence, there is some reason to believe that man coexisted with the mastodon in North America.

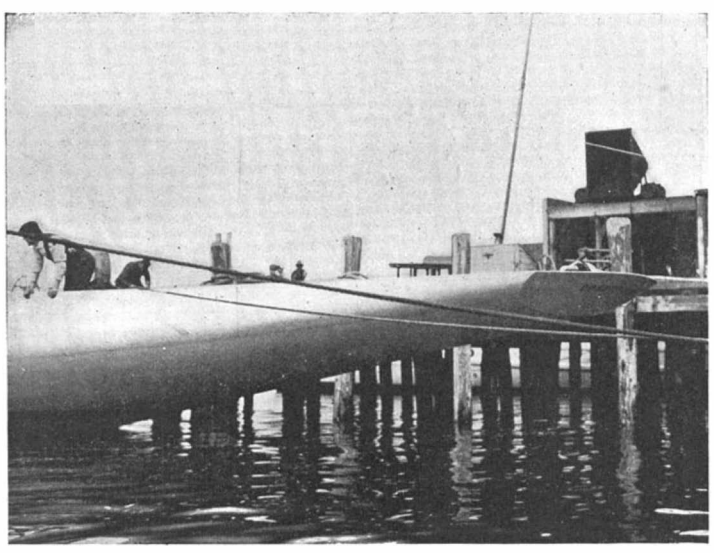
The mammoth (*Elephas primigenius*) lived in North America at the time of the mastodon and probably survived long after the latter disappeared. It is certain that prehistoric man hunted the mammoth in Europe, for numerous remains of carved mammoth bones are found in the caverns of the Vézère and at other places in France. Among these is a rude drawing of the mammoth executed upon a slab of mammoth ivory.



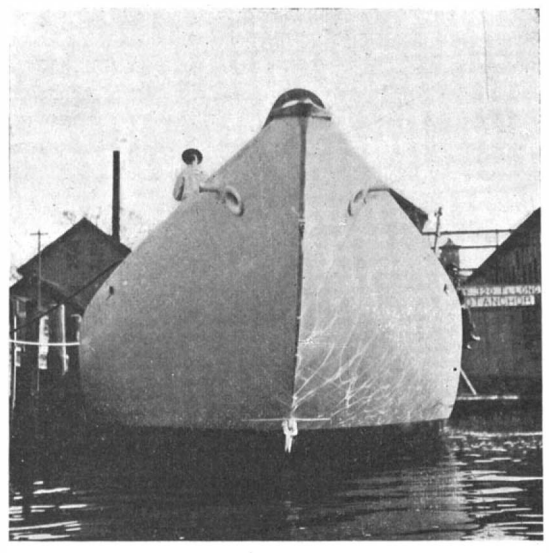
THE MASTODON AT THE BROOKLYN INSTITUTE MUSEUM.

LAUNCH OF THE "CONSTITUTION."

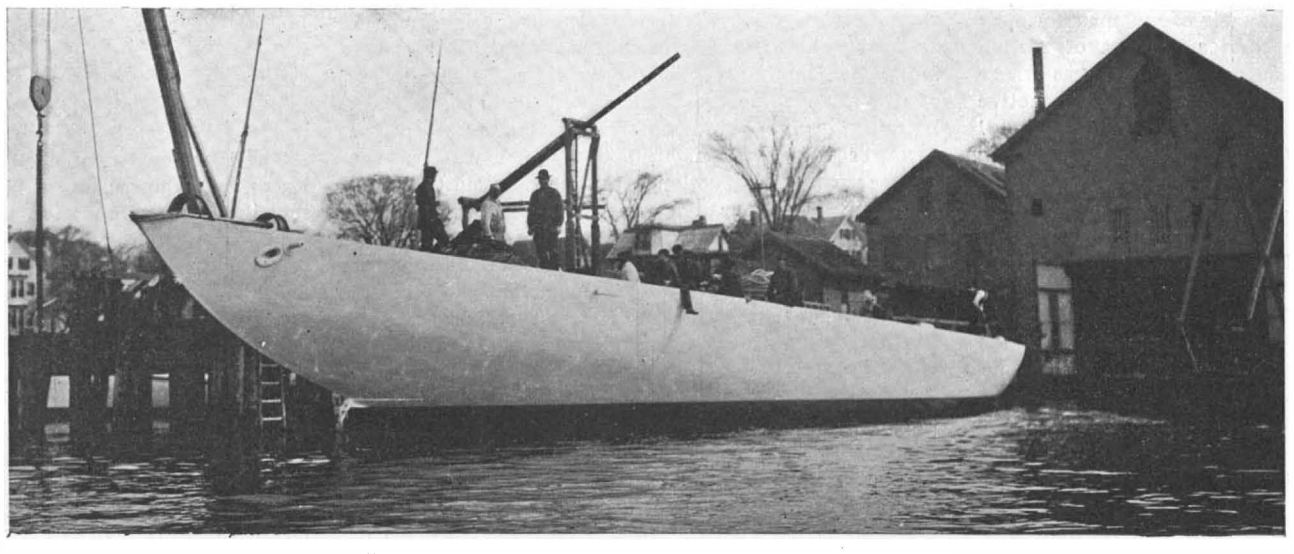
The accompanying photographs, which were taken the day after the launch of the "Constitution," are instructive as showing the difference between "Constitution" and "Columbia," at least in that portion of the two boats that shows above the water-line. In our last issue we gave full plans of the construction of the new boat, and stated that the chief difference would lie in the saving of weight in the hull of the boat, due to the adoption of an entirely novel system of framing, and in an increase of beam by exactly one foot. The dimensions of the "Constitution" are: Length over all, 132 feet 6 inches; beam, 25 feet 2½ inches; draft on normal displacement, 19 feet 10 inches, at which draft the water-line length will be 89 feet 9 inches. In a comparison with the "Independence," which may be taken as representing the most up-to-date construction of the conventional type, it was shown that the longitudinal framing adopted in "Constitution" has resulted in the reduction of the total weight of the plating from 30 tons in "Independence" to 22 tons in the Herreshoff boat. There is also a saving as compared with "Columbia" due to the substitution of a plate-steel deck covered with cork tiling for the relatively heavy wooden deck used in "Columbia." Against this reduction of weights is to be put the fact that the sail-plan of the new boat has been increased by 10 per cent over that of "Columbia," which means that the spars and rigging must be proportionately stronger and heavier, and that the weight of 1,300 square yards of extra canvas must also be added in. The extra weight due to this increased sail spread, moreover, is carried at an average height of 40 or 50 feet above the deck and, therefore, will offset some of the weight saved in the hull plating and deck. Moreover, the body of the boat is larger, and this again will offset some of the weight saved. But even after all is said and done, it is probable that although "Constitution" is a larger and far more powerful boat, her displacement will be about the same as that of "Columbia." The photographs show at once that there is much more boat above the water, her freeboard being from 9 inches to a foot greater than that of her predecessor; in fact, she has such high topsides as to be suggestive in this respect of "Shamrock II." The tumble-home which was so marked in "Columbia" is less noticeable in the new boat. The bow is very lofty and its sections are more round and full, giving the boat a more seaworthy appearance, and suggesting that she ought to make splendid weather of it when thrashing her way to the weather mark against a strong breeze and a lumpy sea. The quarters and stern appear to be deeper than those of "Columbia," and when she heels, "Constitution" will derive not a little sail-carrying power from the modeling of these long and powerful quarters. At the same time we think that, from an artistic point of view, she is scarcely as beautiful a boat as "Columbia," although she will doubtless beat that boat by from 5 to 10 minutes, according to the state of the wind and sea.



THE PORT QUARTER



BOW VIEW.



"CONSTITUTION" THE DAY AFTER THE LAUNCH.

Mr. Charles Davison, a well-known authority on Seismology, contributes an article on "The Progress of Seismology During the Nineteenth Century" to Knowledge. The following is a short extract: "Changes in the amplitude, period and direction of earthquake-vibrations are readily distinguished without instrumental aid; but seismographs have done more than merely add precision to the evidence of our senses. They have rendered manifest features of the earthquake-motion that would otherwise have passed unnoticed. Still more interesting are the revelations of the horizontal pendulum with regard to the pulsa-

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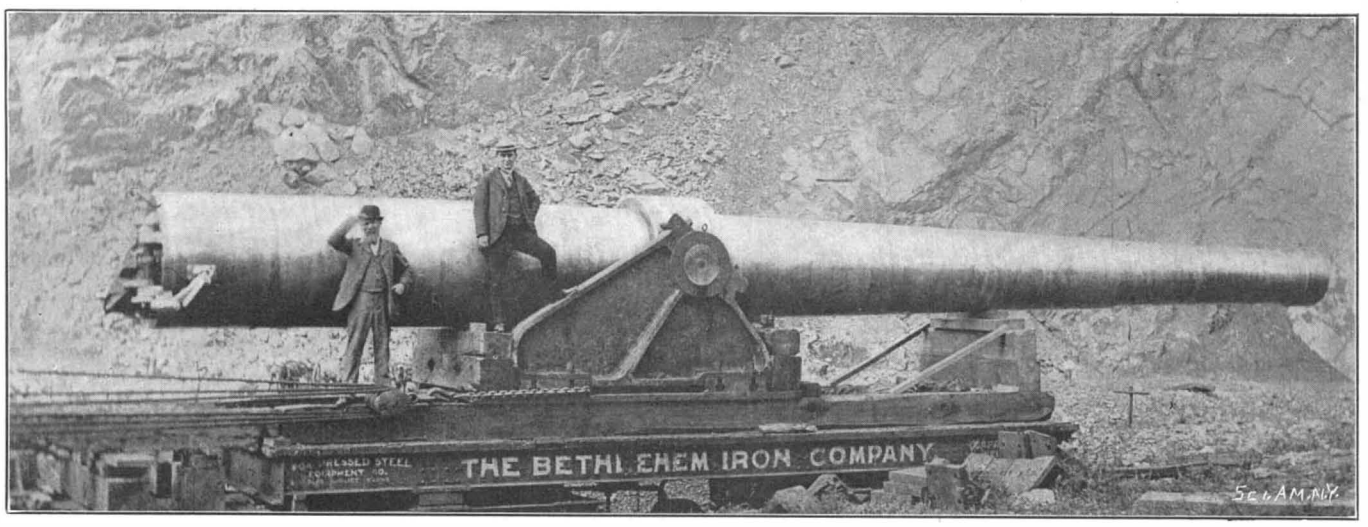
tions of distant earthquakes. By the disturbance of magnetographs, levels, or lakes, the propagation of surface undulations to immense distances had been known for more than a century. For the fuller knowledge gained during the last twelve years, we are indebted to the late von Rebuer-Paschwitz and those upon whom his mantle has fallen—Prof. Milne, Dr. Agamennone, Mr. Oldham and others. Much still remains to be learnt in this fascinating field of inquiry, but it is no slight feat to have proved that, in an earthquake, two series of elastic waves traverse the body of the earth with velocities of not less than 9 and 5 1-3 kilometers per second respectively; while the slow-period undulations spread over the surface at the rate of 3 kilometers per second, the latter having been traced to distances of more than four-fifths of the earth's circumference. It is an achievement worthy of the last years of the century. While the more obvious earthquake phenomena were well known fifty years ago, closer study has revealed others of equal importance. Statistical inquiries have proved that earthquakes are far more numerous than was formerly supposed, the most modern estimate being that one takes place on an average every half-hour."



THE 18-INCH GATHMANN GUN, MOUNTED ON PROOF CARRIAGE.

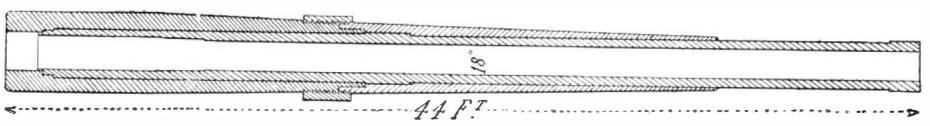


DIAGRAM SHOWING CONSTRUCTIVE FEATURES.

GATHMANN 18-INCH TORPEDO GUN.

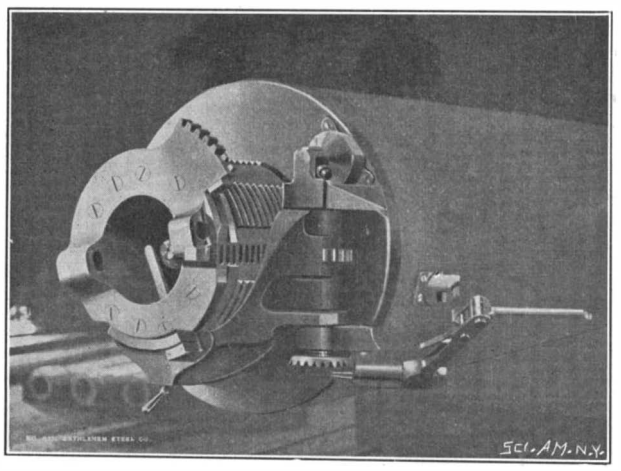
BY EMIL GATHMANN.

The Gathmann 18-inch gun which was recently completed at the Bethlehem Iron Works is essentially a torpedo or high-explosive, shell-throwing weapon. This is the reason for making the gun of so large a bore, as shells containing enormous explosive charges are to be thrown therefrom. The following are particulars of construction and ballistic data, as obtained at recent proof firing at the Bethlehem Proving Grounds, Reading, Pennsylvania.

Total weight	59.6 tons
Total length	44 feet
Diameter over chamber	45 inches
Thickness over powder chamber	13¼ inches
Max. tang. resistance, square inch	40,300 pounds
Max. rad. resistance, square inch	38,500 pounds
Rifling, Gathmann type.	
Twist	Zero to 1 in 25
Powder charge	310 pounds
Gathmann type of rod.	
Projectile	1,800 pounds
Explosive charge of projectile	630 pounds
Pressure in powder chamber	20,000 pounds
Muzzle velocity, expected	2,100 foot seconds

The mean of eight proof rounds fired is as follows: Projectile, 2,000 pounds; powder, 300 pounds; muzzle velocity, 1,900 feet; pressure, 19,000 pounds. From these data it will be seen that with the Gathmann regular 18-inch torpedo shell carrying 600 pounds of desensitized guncotton, total weight only 1,800 pounds, a velocity of about 2,100 foot seconds can be expected with about 20,000 pounds maximum chamber pressure when Gathmann form of powder is used. This will give quite a flat trajectory to any range at which modern ordnance is likely to be employed, and an extreme range equal to that of any service gun. The total energy of impact of an 1,800-pound solid shot at this velocity will be some 55,000 foot tons, which is much greater than can be obtained from the navy's new 12-inch 40-caliber rifle with its 850-pound projectile at 3,000 feet muzzle velocity. The smashing effect of the 1,800-pound shot would certainly be very great. When a Gathmann 18-inch aerial torpedo, carrying over 600 pounds of high explosive, impacts against the target, the striking energy will be truly enormous. The writer has calculated, and Lieut. Meigs, Ordnance Engineer of the Bethlehem Steel Company, agrees thereto, that some half million of foot tons energy will result therefrom.

THE BREECH OPENED.

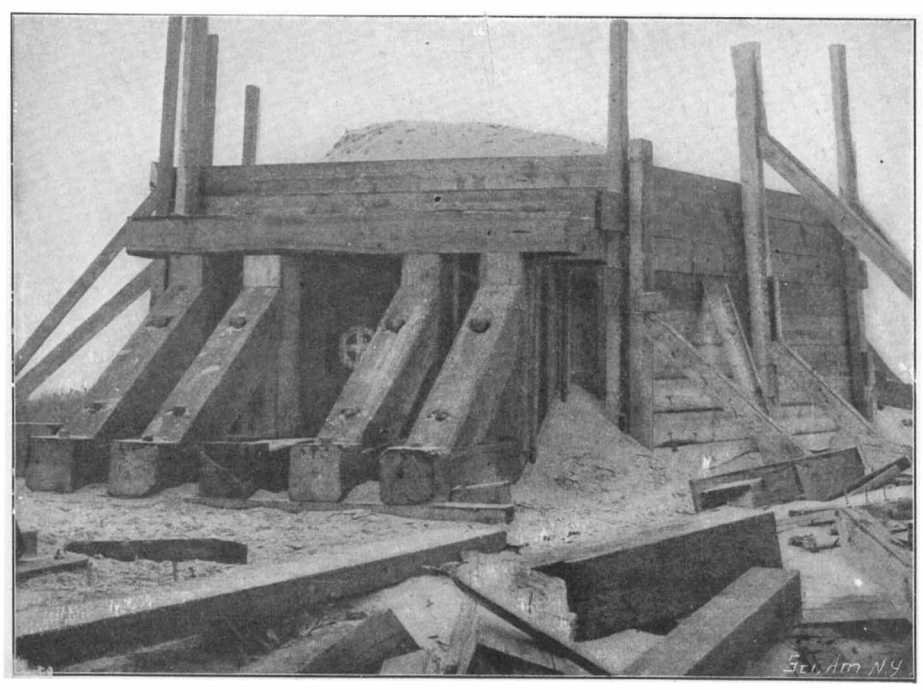


BREECH-BLOCK WITHDRAWN.

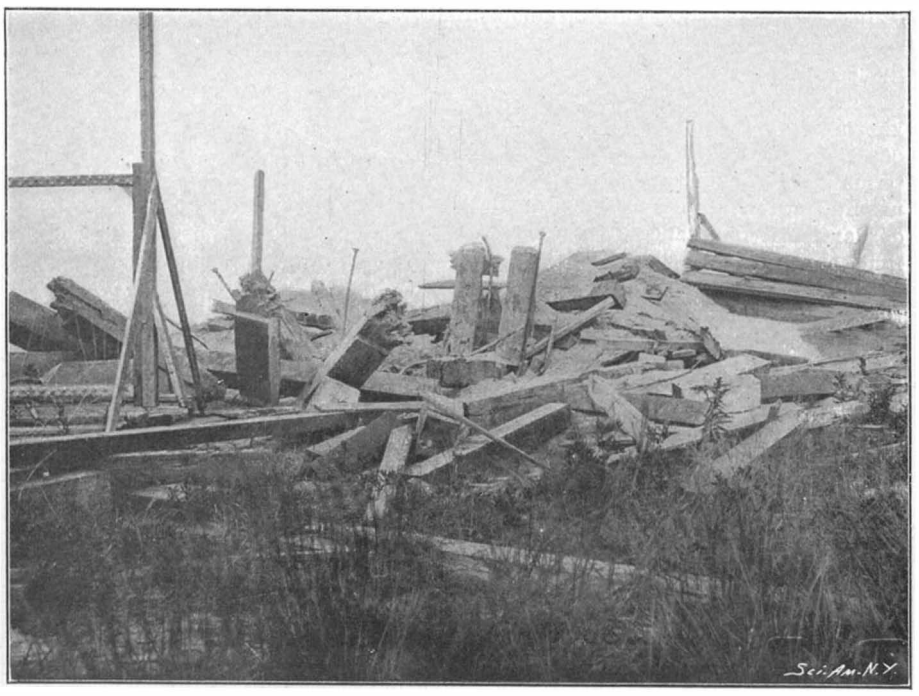
In reply to the experts who tell us that the effects on heavy armor plates of the torpedo shell will be nil, it may be said that from tests already made with 12-inch torpedo shells fired from army 12-inch rifles at high velocity (2,000 foot seconds and over) carrying a charge of from 140 to 200 pounds of wet guncotton, it has been determined that a forward direction is always given to the explosive wave when the torpedo is detonated by a base fuse. Armor plates of 10 and 12 inches in thickness, together with their entire backing, were repeatedly destroyed, or in fitter language entirely obliterated, as can be seen by the official photographs. To determine the effect of very large charges of high explosives against the heaviest of armor plates, a wooden box containing 500 pounds of guncotton compressed in cakes was suspended and placed in contact with the vertical and convex face of a large Harveyized armor plate, 17 inches thick and 8 by 10 feet section. Upon detonation of charge the plate was smashed to fragments and the supporting structure entirely demolished. To obtain full force of any high explosive upon armor plate or other strong structures (that is, to utilize energy in doing disruptive work) it is necessary that explosives be in a very close contact with objects attacked. With the torpedo shell invented by Mr. Louis Gathmann, this condition of close contact of explosive charge with target against which it is impacted is realized. The safety detonator and base fuse devices, the joint inventions of Mr. Louis Gathmann and of the writer, insure with certainty the safe delivery of torpedo from bore of gun, and the detonation of the explosive charge upon impact of torpedo with any resisting target.

The problems connected with the building of the large caliber guns which are needed in this system of ordnance (18 inches in this instance) are principally those well known in the practice of modern ordnance construction and design. Nevertheless numerous new features have been incorporated in the 18-inch Gathmann gun which have proven of great value in actual trial.

A few words more to explain just what is meant by the Gathmann system. The problem has not been one of devising ways and means to get the high explosive out of the gun gently, for desensitized gun-



REAR VIEW OF TARGET CONSISTING OF 10-INCH PLATE BACKED BY 180 TONS OF EARTH.



THE TARGET AFTER BEING STRUCK BY GATHMANN 12-INCH SHELL, CONTAINING 200 POUNDS OF WET GUNCOTTON.

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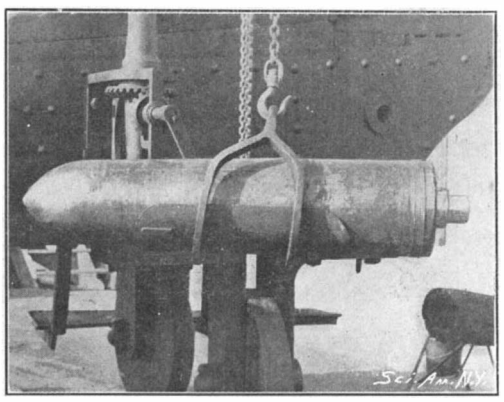
cotton and numerous other high explosives (though we always prefer guncotton) will stand all manner of rough treatment without the least danger. The problems—for there were more than one—have been, in order of their importance, first, an insensitive high explosive incapable of detonation or explosion either from shock in a gun or heat of powder gases, even though exposed directly thereto, and which requires the close contact of strong initial detonation to insure of its own detonation. Second, a detonator or fuse which would insure with certainty the non-detonation or explosion of main shell or torpedo charge of high explosive, until said torpedo had been discharged from gun and had struck a resisting target. Third, a shell or explosive carrier which would give a maximum carrying capacity of explosives for a given total weight, and deliver said explosive in intimate contact with target. Fourth, a form of grain of progressive-burning, propelling powder, which insures a uniform distribution of said propelling charge in chamber of gun, and consequently gives uniform and reliable low chamber pressure, obviating wave action of gases.

That all of the above-named problems have been solved by the Gathmann invention has been proven by the numerous tests already made under government supervision during the last three years, with 6, 8 and 12-inch weapons. The method by which these problems have been solved is termed the Gathmann system. The coming tests of comparative efficiency of the service 12-inch rifle and the Gathmann Aerial Torpedo Gun against two similar target structures of 12-inch Kruppized plates, 8 by 16 feet dimension, will determine the final and really most important problem of all: that of relative efficiency. The torpedo gun and the 12-inch service army rifle are of about equal weight and cost, and the advocates of the new weapon claim that ten hits from the latter will in nowise equal the destruction of one hit from the torpedo shell. In an early issue we shall give the results achieved by the 12-inch gun in firing service shells filled with a high explosive.



TORPEDO SHELL.

POWDER CHARGE FOR 18-INCH TORPEDO GUN.

MALARIA AND ITS PREVENTION.

Since the work of Laveran (1880) proved malaria to be a fever caused by the invasion of the blood by minute animal organisms, steady progress has been made in the work of probing and elucidating the etiology and pathology of this dreadful scourge. English, Italian and German workers have competed with each other in their attempts to limit this dread disease, if not exterminate it, and of their work an immense bibliography remains as a monument to-day.

We have already published a considerable number of papers upon malaria and its prevention, and upon the Anopheles, but a few brief notes relative to some investigations which have recently been carried on may prove of interest. The prime cause of malaria being known, its method of invasion having been satisfactorily demonstrated, and the official seal of scientific approval of these facts having been obtained in Lord Lister's recent address to the Royal Society, it remains now to apply our knowledge in a practical way so as to evolve some method or methods of prophylaxis and thereby crown a piece of scientific work as far-reaching in its power to benefit the whole human race as any of those brilliant discoveries which have made the Victorian age conspicuous above all others. Some of the members of the various expeditions have advocated the wholesale destruction of mosquitoes by surface drainage and by the treatment of their breeding puddles with substances fatal to their development. Others have suggested a careful and more extensive use of mosquito-proof curtains and blinds, while one distinguished authority holds that the continuous administration of quinine is likely to give the best results. The efficiency of surface drainage appears to have been known as far back as 500 B. C., and it is doubtless one of the surest methods of exterminating the mosquito, but in districts unsuitable for any cause, the application of larvicidal substances (petroleum, tar, lime, etc.) has been suggested; but so far as experiments go the effect of such application has proved too transient to be of much value. The general point is to avoid being bitten by infected mosquitoes by night, and also by day, for, notwithstanding statements to the contrary, Mr. R. Fielding-Ould says in Nature that he has repeatedly noticed Anopheles gorging themselves in full daylight, though no doubt their habits are chiefly nocturnal. For this purpose the constant use of mosquito curtains of a prepared kind is essential, but only too frequently one finds in the tropics curtains of an utterly useless kind. Either they are torn or the mesh is too large, or by their arrangement the free ingress of mosquitoes is possible. They are best fixed on four posts on the four corners of the bed, and as the netting descends around the bed, it should be tucked in under the mattress. The inclosed space should be of sufficient size to allow a certain freedom of movement during sleep so that the danger of coming in contact with the netting is impossible. Celli recommends that windows should be protected by wire netting and meshes which measure only from one to one and a half millimeters square and that all doors opening exteriorly should be protected by a cage of similar netting so as to oppose two screens to the ingress of the mosquitoes, as shown in our engraving. He further suggests that to facilitate the capture of any stray mosquitoes, all walls should be bare and painted white, and trees should not be allowed to grow near dwellings, as they afford a retreat in which mosquitoes may hide. Experiments carried out on the Roman Campagna have proved that these and similar devices have been sufficient to protect inhabitants from fever for considerable periods, but it is to be feared that unless unceasing vigilance be exercised all such precautions may prove ineffective, and one mistake may render them entirely abortive.

HUT WITH MOSQUITO CAGE AROUND DOOR, WHICH IS ITSELF MOSQUITO PROOF (AS SUGGESTED BY CELLI).

Liquid air has been tested for blasting purposes in the Simplon tunnel. The cartridges used consisted of a wrapper filled with a carbonaceous material such as equal parts of paraffin and charcoal, and were dipped bodily into liquid air until completely soaked. The cartridges were kept in liquid air at the working face of the rock until required for use, when they were put quickly in the shot holes and detonated with a small guncotton primer. The life of such a cartridge is very short after it has been removed from the liquid air.

London's Electric Tramway.

The first electric tramway in London is now in full operation. The road has been in readiness for some months past, but it was impossible to commence the service, owing to the objections raised by the observers of the Kew Observatory, who stated that their magnetic observations were deranged by the stray currents from the tramway. The Board of Trade instituted an inquiry into the subject, and the result of their investigations has been in favor of the observatory. In view of the urgent necessity of such a rapid means of transit in this part of the metropolis, however, it has been decided to remove the observatory to a more secluded spot, the tramway company to defray about half the expenses of removal. The complete system, comprising about 42 miles, is not yet in full working order, but the complement of passengers carried over the opened section averages between 150,000 and 200,000 per day.

The tramway was originally a horse car system, and its finances were at a low ebb when it was purchased by a small syndicate, headed by Mr. Clifton Robinson, who had previously assisted Mr. Yerkes in the development of his tramways in the West. They decided to convert it to electric traction, and the necessary Parliamentary powers were immediately sought to enable the conversion to be carried out. At first the project encountered violent opposition, but Parliament granted the franchise, subject to certain minor conditions. The overhead trolley system has been employed, since it is considered more economical and easier to repair. In accordance with the requirements of the Kew Observatory, the rails were not employed as the earth return, but the overhead trolley wires are connected up on the three-wire system, the two center wires forming the neutral and the outside wires the positive and negative side. The neutral wire is only grounded at the central station. By this three-wire system greater efficiency is insured.

Color and Germination of Grains.

M. Hoedefleiss has recently made some observations upon the relation which may exist between the color of grains and their germinative value. It is rare that the different grains of the same plant do not present differences in their intensity of coloration. In the case of rye, which the experimenter has specially observed, two groups of grains are noticed as to color, the green and the yellow. To these differences of color correspond differences in germinative aptitude. The green grains appear to germinate more quickly and have a greater germinative aptitude; however, it is found that there is no apparent relation between the color of the grain and the development of the plant formed from the latter. The plants springing from the green grains, and in consequence having come up the sooner, seem to arrive at smaller dimensions in general, and form their grains later.

The Current Supplement.

The current Supplement, No. 1324, is a particularly interesting number. The remarkable skin treatment by electric light at the Finsen Institute at Copenhagen is illustrated and described in detail. "A Curious Old Church in Spoleto" is accompanied by an attractive engraving. There is an excellent picture of the "Shamrock" being towed. "Mechanical Traction in Paris" is the subject of a very full article. "Amadou, Touchwood, Tinder or Spunk: Its History and Uses" is a valuable botanical article by Frederick Le Roy Sargent. "The Corpuscular Hypothesis," which is referred to elsewhere in this issue, is the subject of a most excellent critical article. "A Primitive Frame for Weaving Narrow Fabrics," by Otis T. Mason, is illustrated by 12 engravings, and is a most interesting article. The usual Trade Suggestions from United States Consuls, Trade Notes and Receipts, and Selected Formulæ are published.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

PLOW.—EDWARD B. WINTERS, Coffeyville Kans. This sulky-plow or lister is used without a frame and is so constructed that by means of two devices only, the beam and parts carried thereby can be lifted and held in raised position, or the share can be so adjusted that the point will enter the ground to a greater or lesser extent. The beam is pivotally hung on an unadjustable rear support which is not affected by the adjusting mechanism and is provided with means for sustaining the driver's seat, so that the weight of the driver has no influence upon the beam in its vertical adjustment.

ROTARY WEED-CUTTER AND CULTIVATOR.—THARP BROTHERS, Athena, Oregon. The machine is an improvement in cultivators having a series of rotary cutting-disks so arranged as to work parallel to the surface of the ground. The disk or cutters work slightly beneath the surface to be cultivated and turn independently to the right or left according as the pressure on the individual cutters is greater on one side or the other. They are thus prevented from clogging on the individual edges. Their form and arrangement are also such that the lower side wears away in order to render them self-sharpening. The cutters of one row are opposite the spaces between those of the second row, so that the entire ground is worked and cultivated.

FRUIT-PICKER. — HENRY F. RUGGLES, Vanceburg, Ky. The fruit-picker has a staff along which a collapsible tube extends. Two brail-cords are used to contract and release the tube and are alternately operated. By reason of this arrangement the tube is formed into short lengths through each of which the fruit drops and in each of which the movement of the fruit is temporarily arrested and then permitted to continue on its downward passage.

Electrical Apparatus.

VOLTAGE-REGULATOR. — PHILL S. TIRRILL, Groveton, N. H. This invention is an improvement upon the Tirrill automatic potential regulator for dynamos, the object being automatically to regulate the potential on the supply wires. The present invention is designed automatically to regulate the voltage, to respond to the sudden changes of load or speed, and to cover the range of the rheostat in such a way that its movement can be timed to act just as quickly as the iron of the magnets will respond to the changes made in the exciting current by the regulator, and no faster.

Engineering Improvements.

ENGINE.—ALFRED B. FLOYD, Helena, Ark. This invention relates to steam-engines in general but has specific reference to the mechanism connecting the piston with the drive-shaft, one object of the invention being to provide a simple and efficient construction wherein a piston of long stroke may be utilized to secure a large leverage in the operation of the drive-shaft.

Mechanical Devices.

MEANS FOR CONVERTING RECIPROCATING INTO ROTARY MOTION. — LOUIS KRAMER, Evansville, Ind. To the reciprocating part a body is swiveled and mounted to move in unison therewith. Slides are carried by the body out of alinement with the swivel-axis. The reciprocating movement is converted by a rotary body having spiral threads engaged by the slides and arranged in sets. Theoretically, with absolutely true threads, the swivel-joint would be superfluous, but in practice uneven wear must of necessity result in any mechanical device, and for this reason the swivel-joint is used.

BOAT-PROPELLING GEAR. — JOHN A. FREUND, Brooklyn, New York city. The boat-driving gear is to be driven by the boatman himself, and is composed of a peculiarly arranged propeller-shaft held beneath the bottom of the boat and fitted with a propeller for driving the boat. The interior of the boat is in no way taken up by machinery, so that the capacity is not lessened.

BATTER-MIXER.—STEPHEN H. COOMBS, Helena, Mont. The dough is placed in a pan and kneaded by beaters operated by a suitable form of gearing. As the dough is kneaded, the pan is turned, so that all parts of the dough will be subjected to the action of the beaters.

CABLE-CONVEYER. — DOMINGO ARÁMBURU, Mexico, Mexico. The conveyer consists of a series of sections arranged to receive the material successively, each section comprising two endless cables placed side by side and arranged to move with the load. The distance between companion cables is alternately greater and less in neighboring conveyer sections, so that wide conveyer sections alternate with narrow conveyer sections. Both ends of the cable-runs of a wider section are located side by side with and exteriorly of the ends of the cable-runs of the adjacent narrower sections so as to embrace the ends between them.

AUTOMATIC WEIGHING-MACHINE. — WILLIAM BROUGH, 412 West 28th Street, Baltimore, Md. The inventor employs a tiltable hopper adapted for self-discharge when inclined and provided with weights which can be shifted to vary the leverage of the hopper and thereby weigh and measure different quantities of a liquid or solid. The hopper discharges into funnels which are suspended from it and provided with removable spouts or nozzles to adapt the machine for weighing different commodities.

Railway Contrivances.

LOCOMOTIVE-BOILER. — HENRI THUILE, Alexandria, Egypt. In express locomotives the necessity of having large drivers to reduce the tangential velocity of the parts and the necessity of locating the boiler between these drivers, if it be not desired inordinately to raise the center of gravity, do not permit a diameter of more than 1.25 meters to be given to the boiler. In order to increase the power of the boiler to meet the demands of modern high-speed engines M. Thuile elongates the vertical cross-section and places the boiler between the wheels.

AIR-BRAKE.—JAMES B. O'DONNELL, Freeland, Pa. By means of this new brake an engineer is enabled to recharge the auxiliary reservoir as often as required while the brakes are applied, thus giving the engineer complete control of the train, especially on heavy down-grades, and without danger of the train's gaining any undesirable headway while the auxiliary reservoir is being recharged. The rear cars can be cut out whenever desired.

NUT-LOCK. — WILLIAM A. HANVEY and CHARLES WEST, Big Rapids, Mich. The invention is an improvement in nut locks in which a locking pin is held at one end in the bolt-hole, and is arranged at its other end to be bent alongside the nut. The locking-pin is of special form, being composed of a short length of metal having a body portion adapted to fit in a groove or seat in the outer face of the abutment and provided at one end with a spring point or tongue, bent slightly under the body portion. While the nut is being turned home the locking-pin and cast washer are also secured in place, thus avoiding the necessity of holding the locking device in place until the nut is screwed up.

Miscellaneous.

GUTTER-HANGER AND SCREEN-RETAINER.—MONROE J. DANIEL, Crowley, La. The purpose of the invention is to provide a new and improved hanger and screen-retainer which is arranged to support the gutter or trough securely from a building, to hold the screen in position on the gutter and to permit the convenient adjustment of the gutter to the desired pitch after its attachment to a building.

HAT-FASTENER. — MARTHA B. MOSHER, Manhattan, New York city. The hat-fastener is provided with pins which are mounted in guides on the hat, so that they can be slid in or out of the hair to hold or to release the hat.

GARMENT-HANGER.—FRANK P. JOHNSON, Danville, Pa. This wire garment-hanger consists of two side arms and a supporting-hook. One of the side arms is formed with a trunnion for the other side arm and the supporting hook to turn on. A depending portion from the supporting hook extends between the side arms and forms a stop for them to rest upon when extended, so as to limit the downward swinging motion of the side arms and to hold the hook in a vertical position relatively to the side arms. The entire garment-hanger, by reason of this construction, can be readily folded so as to take up but little room.

SAW ATTACHMENT.—FRANS O. HELSTEN, Laurium, Mich. The labor in sawing through timbers is often considerably facilitated by oiling the saw-blade. Mr. Helsten has fitted a peculiarly-constructed oil-receptacle in the handle of the saw and has invented devices by which the oil may be caused steadily to flow over the saw-blade.

CLOTHES-LINE HOLDER.—HENRY HAFKER, Hoboken, N. J. By means of this simple contrivance the ends of a pulley line can be adjustably connected so that the line can be quickly slackened or its ends disconnected, and as conveniently and quickly stretched and the ends of the line connected and safely held in adjusted position.

CARDBOARD OR PASTEBOARD BOX.—FLEMING T. AUSTIN, 8 Greville Street, Hatton Garden, London, England. The invention relates to cardboard boxes of cylindrical form and provides improved means for fastening the ends or heads of the box within the circumferential portion of the body and cover of the box. Neatness and strength are thereby secured.

CUSPIDOR.—JOHN C. BLAIR, 410 Chestnut Street, Louisville, Ky. A water-pipe is arranged within the cuspidor and is passed centrally through a disk. A flanged spreader is connected with the pipe and has lateral orifices opening below the flange and above the disk. A central screw-valve is arranged in the spreader, its head being accessible at the top of the spreader. The sanitary merits of this arrangement need no comment.

STAPLE.—WILLIAM H. MOREHOUSE, Wasco, Ore. This staple, for use in wire-fencing, has a middle portion forming an eye and split end-portions forming two prongs. The prongs have their inner faces formed with bevels at the points to spread the prongs when the staple is driven into the fence-post. These bevels are of different pitch so as to spread the prongs diversely. The staple cannot be readily displaced.

DRAWING-BOARD.—RUDOLPH ENGELMANN, Manhattan, New York city. The drawing-board is made of metal and is provided with means whereby one or more sheets of paper may be held at the corners on the board and so stretched that the portion of material drawn upon will be without wrinkles and will lie close to the working face of the board. The fastening devices can be quickly adjusted.

LIQUID-MEASURING DEVICE. — HORACE W. WILCOX, Hamilton, Ont., Canada. The novel feature of the invention is a graduated tube, the outlet of which is controlled by a valve. A float in the tube operates to indicate the quantity of liquid discharged by moving downward with the discharging liquid, while the tube is filled with liquid above the float.

BEEHIVE.—BENJAMIN C. SMITH, Coldwater, Ga. The beehive embodies a honey-storing chamber or compartment above a brooding-compartment. Means are provided for protecting the bees from cold and dampness during the winter. The bees are prevented from attaching honeycomb to the rear wall of the honey-holding compartment, this wall being readily moved at any time without fracturing the comb. The honey is removed without jarring the hive or disturbing the brood chamber.

ANIMAL-POKE.—WILLIAM A. HINES, Stafford, Kan. This poke is designed to prevent hogs from passing through a wire fence. Should the hog attempt to pass through the fence, the wires will engage an actuating-lever, forcing it backward and turning a prod-arm to force the point into the animal's nose. When the hog draws back and disengages the actuating-lever from the fence, a spring will return the parts to their normal positions.

DEVICE FOR CONTROLLING FLOW OF WATER IN PIPES.—PAUL P. I. FYFE, Concord, N. C. The inventor has provided such a connection between the water supply and the water-service pipes that the water may quickly flow from one to the other. The connection between the pipes can be cut off any length of time, during which time all the house-pipes will be empty. The water thus freed is conducted to the sewer or other drain. A single slide-valve, operated within the building, accomplishes these results.

SIDING-CLAMP.—OSCAR B. FIKE, Joplin, Mo. This invention relates to improvements in clamps for siding boards of buildings. The clamp provided can be easily manipulated to hold a warped or buckled board in place while it is being nailed. Without interference of the studding the clamp can be slid from one end of a board to another. The device can be operated either by the right or left hand.

ADJUSTABLE SAW-CLAMP.—GRANVILLE BARLETT, 57 Leverette Street, Detroit, Mich. The object of the present improvement is to render the upper portion of a clamp adjustable to either a curved or straight line, so as to permit the filing and jointing of saws to a straight or curved line of teeth as may be desired.

INVALID OR SURGICAL BED. — Dr. ADOLFO LURIA, 291 W. Division Street, Chicago, Ill. The improved apparatus for medical and surgical use devised by Dr. Luria, consists of a surgical table and a pivoted swinging rod bent twice at right angles. Anæsthetic holders are supported on the vertical free-arm of the rod whereby they may be swung and placed in different positions relatively to the table. The table has every possible movement which can be required and is provided with all necessary appliances.

CHILD'S KNIFE BLADE.—MARY A. HERR, Girardeau, Mo. The end of this child's knife-blade is rounded or carried in a curved line from the back beneath the cutting edge. By reason of this construction the child cannot readily cut itself or pierce cushions, sofas, or chairs.

JAR-WRENCH.—ROBERT R. WATSON, Detroit, Mich. A strap is slipped around the jar-cover and engaged by the wrench. A twist of the hand with the leverage thus provided will readily loosen the cover.

RAIL-BENDER YOKE.—GARLAND T. THAYER, South Side Foundry and Machine Works, Charleston, W. Va. The rail-bender yoke is in the form of an arch curving from end to end on a gradual curve approaching the arc of a circle. Hooked feet on the ends engage the rail and a central cylindrical portion receives the screw to grip the rail. Ribs and flanges extend between the central cylindrical portion and the hooked feet, and a head is extended around the outer side of the hooked feet. The device is designed for use in bending and straightening rails.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

THIRTY-SECOND REGISTRATION REPORT. MICHIGAN. Vital Statistics. 1898. Pp. i to clxxii, 38.

Besides the usual vital statistics, this book contains tables of comparison with those of various European countries, Japan, New South Wales, and New Zealand. These tables are of especial interest in comparing the movement of population of an Oriental country with the European, American, and Australasian data presented. Some of Michigan's most typical vital statistics are graphically represented in a diagram, and the Bertillon classification of causes of death forms an appendix to the rest of the data.

ELEVATION AND STADIA TABLES. By Arthur P. Davis, Hydrographer, United States Geological Survey. New York: John Wiley & Sons. 43 Pp.

This book is an elaboration of one published in 1893, which contained a table of elevations for field use. An additional table carries up to 26 degrees, the difference in level in feet for one mile. A third table gives the curvature and refraction, $h_2 = 0.574\ D^2$, up to 40 miles for use in refined computations. Two more tables for use on work of larger scale where the distance and elevation are both in the same unit, as feet or meters, carry up to 40 degrees the difference of level for a slant distance of 100. These are especially useful for stadia work, and are supplemented by a sixth table giving some usually negligible corrections that may be introduced when very refined work is desired. The book also has a table that will be found useful for the calculation of slopes not given in canal and river work, and which gives the velocities direct for most practical problems in canal construction.

RESERVOIRS FOR IRRIGATION, WATER POWER, AND DOMESTIC WATER SUPPLY. By James Dix Schuyler. New York: John Wiley & Sons. 432 Pp. 183 illustrations, and 20 plates. Price $5.

The author of this work states that it is the outcome of a hastily written paper by him in the Eighteenth Annual Report of the Geological Survey on the principal dams and reservoirs of the arid region of the United States. Although he does not claim that the book is an exhaustive treatise of the subject, he seems to have treated it quite fully, and the volume will without doubt be found of great assistance by civil engineers and all others interested in the matter of water supply. Besides illustrated descriptions of the different kinds of dams that have been built the book contains a chapter on projected reservoirs, and discusses in full the available water supply for irrigation in the various sections of arid America. The distribution, application and use of water; the rainfall and run-off; the evaporation from and effect of silt upon reservoirs are all fully discussed. Photographs of the Austin Dam in Texas just before and after it broke are among the most interesting in the book.

ANNALS OF THE ASTRONOMICAL OBSERVATORY OF HARVARD COLLEGE. Vol. XXXVII., part 1. Observations of Circumpolar Variable Stars During the Years 1889-1899. Prepared for publication by Oliver C. Wendell, under the direction of Edward C. Pickering, Director of the Observatory. Cambridge: Published by the Observatory. 1900. Pp. 144.

The observations described in this pamphlet differ in two respects from those previously made elsewhere. First, the stars have been observed throughout their variations of light, observations at minimum being considered as important as those at maximum; and, second, all the observations were reduced to a uniform photometric scale which was that of the meridian photometer. The observations thus make it possible to compare not only the light of a given star at different times, but also to compare one star with another, even if the two be in widely different parts of the sky.

TRANSACTIONS OF THE WAGNER FREE INSTITUTE OF SCIENCE OF PHILADELPHIA. Vol. III., part 5. Philadelphia, Pa.: Wagner Free Institute of Science. December, 1900. Pp. 949-1188. 12 plates.

This part of Volume III. on the contributions to the tertiary fauna of Florida describes especially the silex beds of Tampa and the pliocene beds of the Caloosahatchie River. It includes a large part of the Teleodesmacea, and gives a revision of several groups in which heretofore great confusion has reigned. A very large number of unrecognized species will be here found, described and illustrated for the first time.

INVENTOR'S MANUAL. How to Work a Patent to Make it Pay. By an Experienced and Successful Inventor. New revised and enlarged edition. New York: Norman W. Henley & Company. 1901. 16mo. Pp. 115. Price $1.

The little volume before us is a guide to inventors in perfecting their inventions, taking out their patents and disposing of them. The advice in regard to selection of patent attorneys is good, and can be summed up in saying, "Go to a reliable patent attorney." Besides instructions of various kinds, it contains forms for applications, assignments, etc.; tells how to form a company; gives the laws regulating sales, about selling agents, whom to avoid, etc. Many inventors fail to realize upon their inventions just from the lack of a little manual like the present. It contains the twelfth census of the United States by counties of over 10,000 population, compiled from the official census of 1900.

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FOR SALE.—Patented invention, "Nut Lock." S. Koralewski, 19 Eagle Block, 20th Street, Pittsburg, Pa.

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Inquiry No. 635.—For parties having facilities for making pens.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4. Munn & Co., publishers, 361 Broadway, N. Y.

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Inquiry No. 644.—For machinery to straighten iron pipes warped by fire.

Inquiry No. 645.—For quarry stripping machines.

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Inquiry No. 647.—For manufacturers of adhesive tacks for hanging pictures.

Inquiry No. 648.—For an improved process for extracting the juice out of living India rubber trees.

Inquiry No. 649.—For dealers in oxide vanadium, or a salt of the metal.

Inquiry No. 650.—For manufacturers of novelties for the mail order business.

Inquiry No. 651.—For cautery batteries, knives and burners for surgical use.

Inquiry No. 652.—For rotary knives.

Inquiry No. 653.—For crude oil burners suitable for heating and cooking stoves, also an apparatus for burning crude oil in furnaces and boilers.

Inquiry No. 654.—For second-hand pinion cutter for cutting pinions about 2 to 10 inches in diameter.

Inquiry No. 655.—For manufacturers of hemlock tanned leather ⅛ inch thick.

Inquiry No. 656.—For parties to manufacture a new electrical device that has a balance wheel and hair spring enclosed in a nickel-plated case, with a brass bezel and glass front.

Inquiry No. 657.—For a second-hand Otis elevator engine 7-inch cylinders right hand.

Inquiry No. 658.—For second-hand 10 horse and 5 horse motors and arc light dynamo of 30 lamps.

Inquiry No. 659.—For a 48-inch swing lathe, bed not over 10 feet.

Inquiry No. 660.—For manufacturers of electric fans for hotels.

Inquiry No. 661.—For bolt header or other inexpensive machine for making pins, etc., ¾-inch to 1⅛-inch diameter; also machine for punching ⅛-inch holes through such pins.

Inquiry No. 662.—For apparatus for bottling soda pop, and for the necessary bottles.

Inquiry No. 663.—Wanted at once from stock soft bright (white) ribbon steel as a substitute for sheet brass, sizes about No. 13, ¼ inch wide; No. 16, 1½ inches wide; and No. 20, ⅝ inch wide.

Inquiry No. 664.—For dealers in small stamped out articles made of leather, such as tops for umbrellas, mattress tufts, etc.

Inquiry No. 665.—For manufacturers of all kinds of ax handle machinery.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

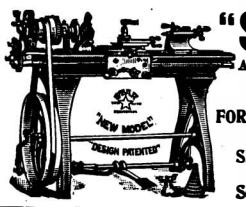
Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(8184) F. P. H. asks: Would you, through your information department, tell me why a condenser on an induction coil reduces the sparking at the platinum point of the circuit? A. When the primary circuit of a coil is closed, a current is induced in the primary coil by the rush of the battery current through it, which flows in the opposite direction to the battery current, and thus weakens and retards its effect. When the circuit is broken a current is induced in the primary circuit in the same direction as the primary, or battery current, which thus increases the effect of the battery current. This is called the *extra* current. It is this which produces the spark at the platinum point, which would be rapidly burned away, were it not for the condenser. When the circuit is broken, the large surface of the condenser is a reservoir, as it were, to receive the rush of the current. As soon as it is full, the condenser discharges itself backward through the primary coil, to which it is connected for this purpose. This discharge, being in the opposite direction to the primary current, demagnetizes the core very rapidly and makes the secondary spark on the break much stronger. The spark at the platinum point is prevented because the current can rush into the condenser easier than to jump the spark gap at the platinum point. This is, however, only one object attained by the condenser. The outrush of this charge makes the secondary spark at break much larger. Indeed, in a coil properly adjusted there is no secondary spark at the closing of the primary circuit, but only at the break of the circuit.

(8185) T. J. Y. asks: 1. What is the difference in the winding of a bridge and series telephone bell? A. The armature of the bridging magneto is wound to a higher resistance than that of the ordinary or series magneto. 2. Can a series bell be rewound so as to make it a bridge bell? If so, how? Can they be so rewound and used without rewiring the 'phone? A. The series armature may have from 300 to 650 ohms, while the bridging bell has its armature wound to 1,000 to 1,600. If there is room for the wire, it may be added to the present coil till the proper resistance is reached. Otherwise the old coil should be unwound and replaced with wire which will give the proper resistance. No. 33 wire is commonly used for the coils. 3. Can you recommend some cheap book on telephones and their construction that would give this and other information in full? A. The best book is the cheapest in the end. This is Miller's "American Telephone Practice," price $3 by mail. It covers the subject.

(8186) M. T. H. asks: I would like to know if malleable iron has as high a permeability as wrought iron or steel, and which is the best? A. Malleable cast iron is intermediate between cast and wrought iron, and mild-annealed steel has very nearly the same permeability as wrought iron. Soft steel is much used for cores of dynamos. Wrought iron or mild steel is the best.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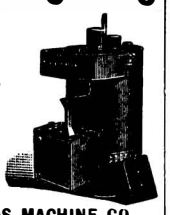
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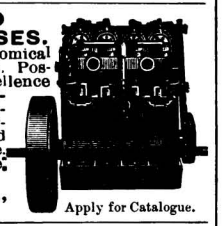
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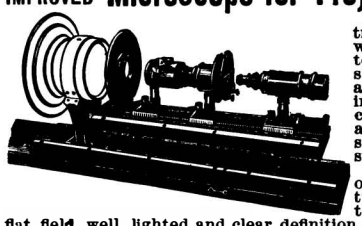
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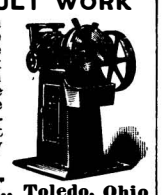
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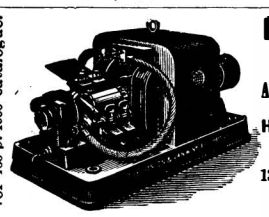
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INDEX OF INVENTIONS

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AND EACH BEARING THAT DATE.

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(Continued on page 317)

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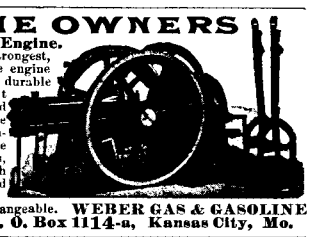
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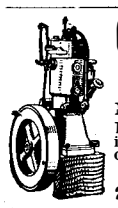
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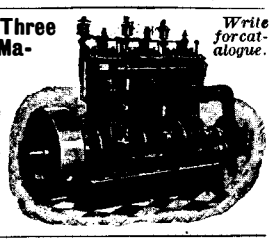
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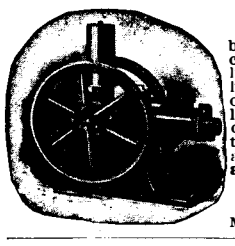
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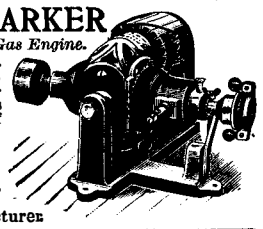
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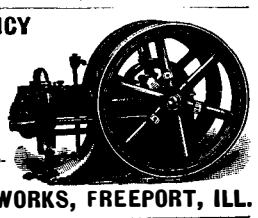
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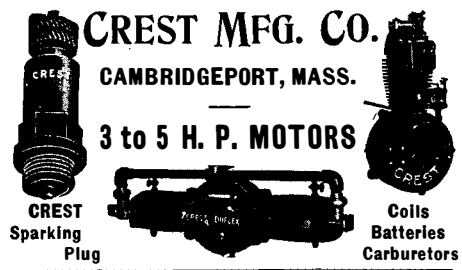
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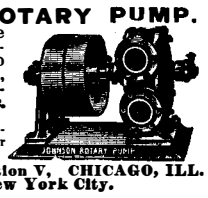
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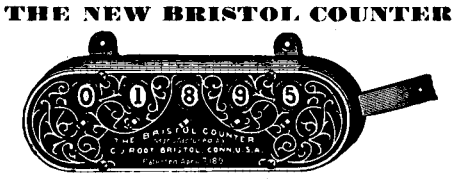
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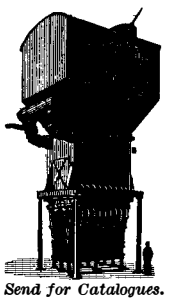
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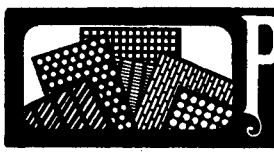
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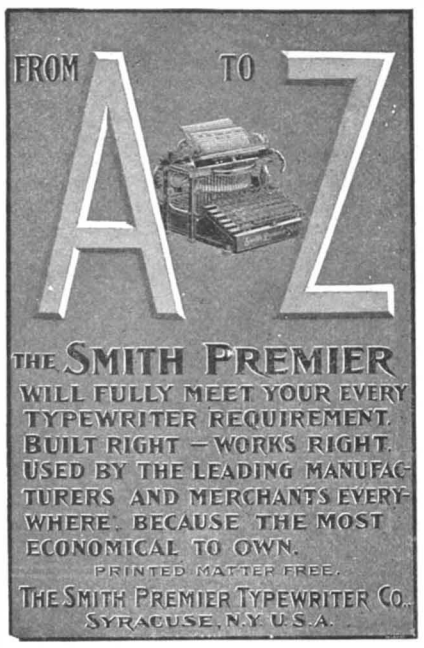
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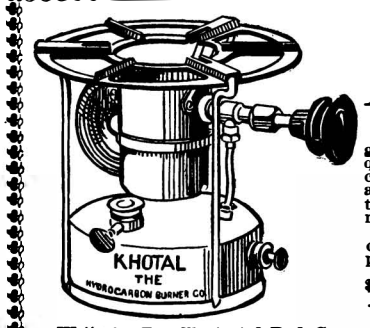

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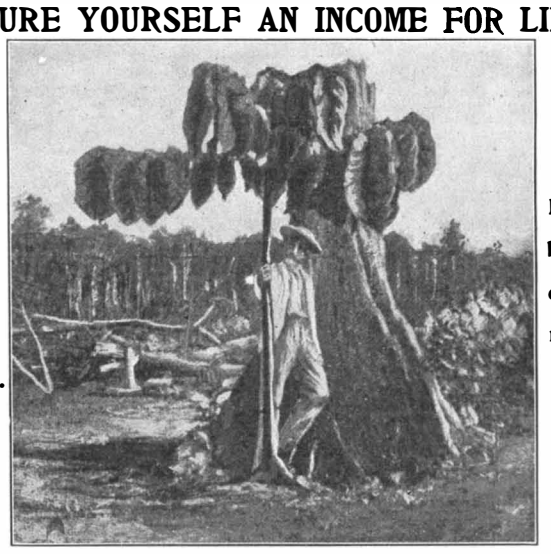

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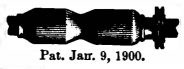

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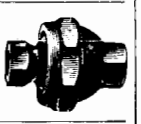

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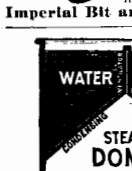

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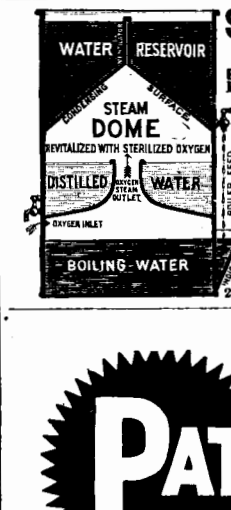

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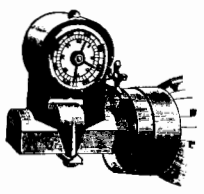

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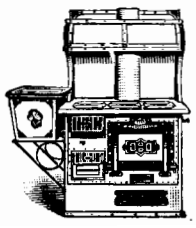

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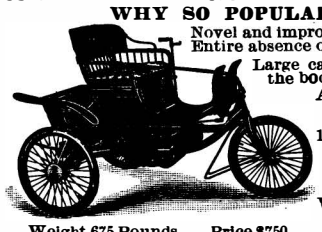

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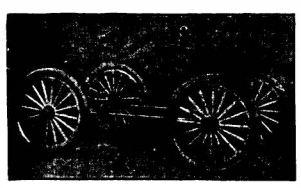

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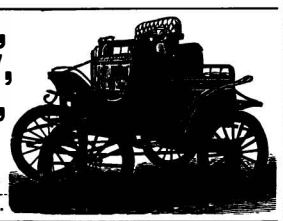

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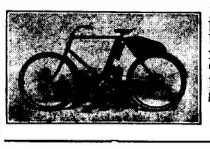

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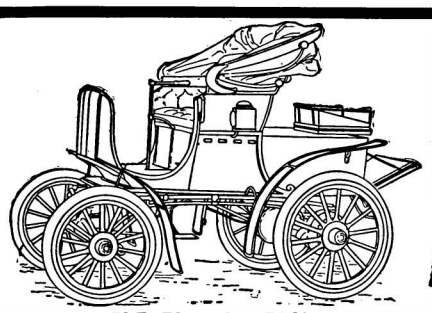

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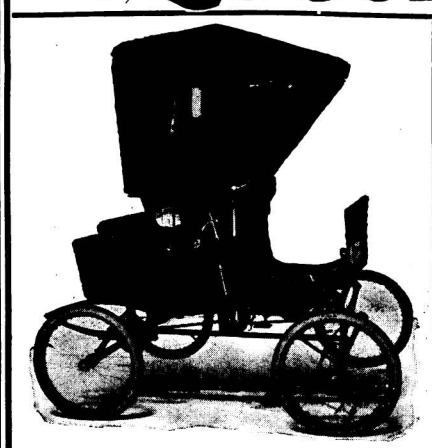

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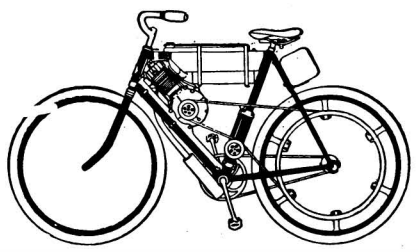

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